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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTION OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION.

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Defects in Cupola Practice.

We would draw the attention of our readers to a very important point which was brought out in a Paper read by Dr. Moldenke before the Rochester Convention of the American Foundrymen's Association, an abstract from which appeared in the June 29 issue of THE FOUNDRY TRADE JOURNAL. According to Dr. Moldenke's experiments, the mixing of charges in layers in the cupola does not guarantee that they will be separate when casting. In other words, if a special mixture is required, it is useless to sandwich it in the course of an ordinary run. If cold-blast iron is to be used for just one casting, and constitutes one charge by itself, its characteristics will be lost. The logical conclusion to be drawn from the experiments is that if a special mixture is required, that mixture must constitute the major bulk of the run. Dr. Moldenke's views are confirmed by a remark which appeared in Mr. J. Cameron's Paper on Semi-steel, read before the Birmingham Conference, stating that "one disadvantage in regard to semi-steel is that, while it is comparatively easy to maintain good results when worked daily on a large scale, the writer has to admit, after considerable experience, that to ensure the best results it has to be handled on a fairly large scale. When only one or two charges are required, they can certainly be produced and ordinary iron reverted to, but the results are never so good, so far as tests are concerned, as when melted on the larger scale."

Now, we submit, that, according to Dr. Moldenke's experiments, exactly the same thing applies to any special mixture, and the problem, therefore, resolves itself into one: that no special mixture can be adequately obtained by means of an ordinary single charge in the course of a normal run.

It would be well for foundrymen to consider what course they should take when the occasion arises. They have the choice of a small reverberatory furnace, the efficiency of which is questionable, but recently, we are pleased to note, more attention has been given, and now baby reverberatory furnaces are on the market, having a reasonable efficiency. Though primarily designed for non-ferrous work, they may be worth while for the dual purpose of special mixtures and experiments. Then, of course, there is the crucible. This, too, has been modernised and can show a considerable saving over its prototype. Finally, there is the electric furnace. It does not seem to be generally realised that the electric furnace will be found in many British foundries in the future. At the moment, iron foundrymen are waiting for another firm to start, because they realise that the first firm will have to meet a heavy experimental bill, which, as the experience gained becomes common knowledge, will not be a charge upon the later ones to take up the process. At the moment the situation is that cold-blast iron, refined iron or semi-steel only impart their best properties to the resultant material when made in bulk, and if one small or medium-weight casting of special composition is required, another process must be resorted to. In this country, no doubt, baby cupolas can often meet the case, but, we assert, that every foundry worthy of the name should install a special plant for the purpose of experimenting and making special castings of definite composition.

American Machine-Tool Merger. — Five leading American machine-tool manufacturing companies, after negotiations extending over a year, have been merged under the name of the Consolidated Machine Tool Corporation of America. Articles of incorporation have been filed in Delaware with capitalisation at $30,000,000. The companies concerned are the Betts Machine Company, Rochester, N.Y.; Colburn Machine Tool Company, Cleveland; Hilles & Jones Company, Wilmington, Del.; Modern Tool Company, Erie, Pa.; and the Newton Machine Works, Philadelphia. The headquarters of the Corporation will be at 17, East Forty-second Street, New York.

U.S. Bureau of Commerce.—The Iron and Steel Division of the U.S. Bureau of Foreign and Domestic Commerce has been extended by the addition of a Mineral Section, which will cover all minerals, metallic and non-metallic, except fuels, iron ore, and such ores and ferro-alloys as are intimately associated with iron and steel. Refractories will receive special attention, and the major metals with which it will deal will include copper and alloys of bronze and brass and their products; lead, zinc, and tin and their manufactures. The refractories materials will involve such products as fireclay, magnesite, chrome, and silica brick and clay products except earthenware and pottery. Mr. James A. Stader, a mineralogical expert, has been placed in charge of the new Section.

XUM

New Methods of Testing Cast Iron.*

DISCUSSION.

Tensile Tests Criticised.

PROF. TURNER, who was called upon to open the discussion, said they had brought before them in the paper a system of testing which was novel, and which might be revolutionising in its effects. One realised at once that it was a great advantage to be able to take a piece of the actual casting and test that instead of depending on outside testing, which might or might not correspond with the character of the main casting. They had had methods of testing the hardness of the interior of a casting by drilling holes under suitable conditions, but though those drillings might be analysed they did not give an opportunity of testing the physical character of the metal. In this method of testing, a cylinder was drilled and pieces could be cut off and examined, by compression or shearing test. He gathered that the author did not approve of tensile tests for cast iron, and he (Prof. Turner) knew some of the objections raised to it, but he must say his own experience had been that, provided one could get a straight pull, which was the essential point for cast iron, the tensile tests were of very great value. They must remember, however, that they used cast iron for purposes which were quite different in many cases from the purposes for which they used steel. If they required the properties of steel obviously they should use steel; if they required other properties then the cheaper material, cast iron, could be used with advantage. They had been too much in the habit of testing cast iron by methods which were applicable to steel. It might be advisable, as suggested in this paper, to consider together (he thought the idea of a joint committee was an admirable one) what were the best tests on such occasions. He was interested in the sounding tests described by M. Ronceray, because those methods had been used for steel. They gave a ready method with rods of similar characteristics of discerning the amount of carbon: the higher the percentage of carbon the higher would be the note when the rod was struck. But the greatest fundamental fact in the test was that the casting should be of a suitable shape, because there were so many castings that were not suitable for the sounding test. In many other cases, however, by hitting the casting with a hammer and listening to the note it gave one could get a considerable amount of information as to the elastic properties of the material. The paper would, at all events, cause them to think seriously, and would, he believed, be of considerable benefit to the industry.

Impact Test Recommended.

MR. SHAW, in thanking M. Ronceray for his paper, said that all were pleased to learn how foundry matters are conducted in France. M. Ronceray had been a member for the last 13 years, yet this year he gave his first contribution to the Proceedings. It was to be hoped that now the ice was broken that either he or his compatriots would often favour them. The author had taken for his subject one that was full of interest at the present time, when the question of tests were before the Institution. He (the speaker) agreed with M. Fremont that the transverse test was the best one for grey cast-iron. He also agreed that the tensile was not a true index of the quality of the metal. This might be in part due to the difficulty in obtaining true alignment in the machine, but more from the fact that the tensile test was a measure of the structure of the iron rather than its quality. Mr. Field had unwittingly made a statement that tended to bear that out, when he stated he could obtain a 1.5 per cent. semi-steel that would give 17 tons tensile, but could not guarantee the transverse. This was also borne out in M. Fremont's paper, given before the International Congress in 1912. With regard to the impact test with the French machine, after two years' daily use he found it gave the best indications of the quality of the iron.

There was no doubt Mr. Fremont's idea was the correct one; no test would enable one to say a casting was a strong one, better than tests taken from the actual casting. Whether the small bars used (roughly 5-16th in. × ⅜ × 1⅛ in.) were large enough to give a true indication of the transverse strength, and more particularly the deflection, was open to serious doubt. It must also be remembered that in drilling with the hollow drill, the resultant test piece would be closer in grain at the beginning and ending of the operation, as they consisted of the outer skin of the casting. The centre of the bar would be of a more open structure. As the top V-piece of the machine would exert pressure at this point, the resultant test would be lower.

With regard to the shearing test, he understood that a constant was found from a comparison of the results of the 110 transverse tests with the resistance to shearing of these same bars. This might hold good for the metal under consideration. If they took it that resistance to machining bore some relation to shearing, they all knew how much harder to machine some test bars were than others giving the same transverse test. The very fact that these methods which had been advocated since 1909, and seemed so ideal, had made so little progress, even in France, pointed to a weakness somewhere.

Commercial Aspect of Testing.

MR. J. R. HYDE welcomed the paper as pointing out the position that tests of cast iron occupied to-day. The Institution of British Foundrymen were taking steps to put their house in order. Although M. Ronceray might understand something of the complex nature of cast iron, and the variation in mass, and the influence mass had on strength, they had to give a test to the engineer that he could reasonably understand, and he (Mr. Hyde) would submit that the tensile test was one of the things they must carefully study. If the defect was in the testing machine, then let them put it to the engineer that he must give them a testing machine which would correct the defect, so that their material should not suffer. Having got that they were provided with an interesting test which would help them to study the true nature of cast iron. With regard to the other tests mentioned by M. Ronceray, they were distinctly interesting, and members must hope that in the near future some research would be undertaken to compare the various tests and draw some conclusion.

Composition Difficulties.

MR. YOUNG remarked that M. Ronceray had said something that nobody in this country seemed to have the pluck to say. He said:—"It seems almost unbelievable that, even in this time of progress and science, the qualities of cast iron have been observed on separately-cast test-bars which are entirely different in structure from castings." Not only did they not admit that in this country, but they had apprentices in the Institution of British Foundrymen who were taught that test-bars should be cast separately from castings. That meant to say that they wanted to imitate the arbitration bars. Yet here was M. Ronceray saying it was almost unbelievable people could make tests like that. He (Mr. Young) had made a great many of these arbitration tests, and he had no account of any bar cast separately from the casting having the same composition as the casting itself. Therefore they were up against this, not only that the testing was different but that the composition itself was different. In his own recent experience they had been cutting bars out of the castings.

The Author's Reply.

M. RONCERAY, replying, said the elongation in cast iron was exceedingly small, and the slightest defect in a test made a vast difference in the result. That was a difficulty with regard to the tensile test. You might have a very good casting yet the tensile test might seem to prove it was no good. The sounding test was very sensitive. Of course, the results of a test depended not only on the

* Paper read by E. V. Ronceray before the Birmingham Conference.

analysis and the quality of the iron, but on the way it poured in the casting, on the way it was cooled in the casting, and on the way it was handled afterwards. Sometimes it could be left in the sand, sometimes it was got out quickly. He had often, by way of experiment, cast two testing pieces in the same box from the same runner and got very different results. It was surprising what differences of strength there were in metal bars of the same composition. The speed of cooling was of the first importance, and also the method of taking out the gases. He thought the greatest improvements to be expected in the foundry would come not from small differences of composition, but from the treatment of the metal in the cupola, and afterwards until the casting was delivered.

Overcoming a Waster.—III.

The accompanying sketch is of a casting weighing about 2½ tons. The section shown is just sufficient to convey to the reader how this job was made and how it failed. It was made in strong sand, blacked and dried. The first one, when finished, was fastened by cast-iron clamps upon all the lugs of the moulding box A. When the mould was cast and the greatest pressure came on the mould, one of the cast-iron clamps broke, and the metal burst out. The usual means were adopted to save the casting, even to the extent of putting another clamp on while the molten metal

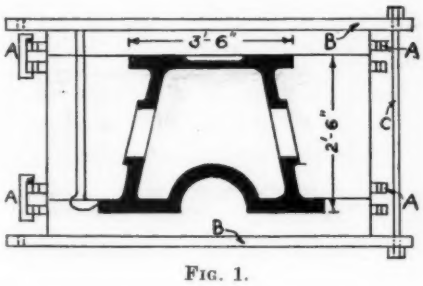

FIG. 1.

was still running out, and although this was achieved, and more metal was poured in the mould, yet when the casting was taken out of the mould next day, it was found that the bottom flange at the point where the metal ran out was much thicker than it should have been, and by the metal running out of the runner cut, the dirt had got into the mould, and spoilt the machining parts. These two defects rendered the casting useless for the purpose for which it was required.

The second mould was secured by the better method, *i.e.*, bars being placed under and over the moulding box B, and then bolted at C, this proving quite successful.

Unemployment in the Iron and Steel Industries.

The numbers registered as wholly unemployed in the trades classed under the heading iron and steel manufacture were 150,361 on May 27, 1921, 91,395 on December 2, 1921, and 89,821 on May 22, 1922, SIR M. BARLOW stated recently in the House of Commons. The corresponding percentages of unemployment were 57.3, 35.1, and 34.1 respectively.

Gothenburg Fair.—The results of the Gothenburg Fair, which closed recently, exceeded all expectations.

Tungsten in Siam.—During the Siamese year 130 (1911-1912) the tungsten output was 180 metric tons, and in 1912-1913 it rose to 309 tons. During the Siamese year ending March 31, 1917, altogether 584 tons were exported, and in the following year the monthly shipments reached 70 to 80 tons. In the year 1916-1917 some 65½ short tons were shipped from Bangkok to the United States, but in 1917-1918 only 22.5 short tons. The consignments for the French Government were considerable. The ore carries as a rule from 25 to 30 per cent., in some cases up to 50 per cent., of tungsten trioxide.

German Iron Imports from Polish Silesia.

The regulation of the new frontier in Upper Silesia took practical effect on June 18, but difficulties have arisen in Germany in regard to the import of rolled products from Polish Upper Silesia. The Treaty of Versailles stipulates that Polish products are exempt from Customs duties on entrance into German territory for a period of three years, such period beginning with the notification of the new frontier to Germany and Poland. The Treaty, however, provides that the Polish Government has to prepare a list of the products thus to be imported into Germany duty-free, and that it is only when this "free list" has been duly presented by the Polish to the German Government that the Customs exemption for the products therein specified comes into operation. The Polish Government submitted a free list towards the end of June, but it only specified the products in a summary manner, without regard to the requirements of the German Customs Tariff. As a consequence, the German Government has been unable to utilise this list as the basis of duty-free trading, and has consequently prepared a list of its own, based upon the Polish list but embodying the requirements of the German Tariff. It is assumed that the consent of the Polish Government will be obtained for this amended list, but in the meantime exemption from duty of the products specified therein, including rolled products, is not allowed.

Pending an understanding on the matter, the Economic Association of German Iron Merchants has recommended its members (1) to instruct the works to send with their deliveries all documents necessary for Customs purposes; and (2) to propose to the Customs Houses a postponement of the Customs action, which can usually be effected for three months subject to certain guarantees. The Association has also requested the Ministry of Finance to instruct the Customs officials to give full consideration to such applications for postponement, and to refund any duties paid immediately after an agreement as to the practice has been reached.

As rolled products belong to the class of imports which are prohibited without a licence, the Association recommends members to apply to the National Commissioner at Düsseldorf for permits.

Electrically-Heated Metal Pattern.*

By C. A. Cremer.

This paper takes up the development of an electrically heated pattern plate. When moist moulding is rammed up around a cold metal pattern, a thin film of moisture collects on the surface so that when the pattern is withdrawn from the mould, there is a tendency for some of the sand to adhere to it. For many classes of work, it is essential that the castings be smooth and clean and therefore means must be taken to overcome this tendency for the sand to stick to the pattern. Two means are at hand to prevent sticking, one by frequently dusting the plate, the other by heating the plate. The use of dust takes time and results in some cases in imperfect castings. Gas flame heating has been used in connection with stationary machines. The disadvantages of the use of gas-heating methods are discussed.

The development of an electrically-heated pattern plate to overcome the trouble encountered in heating with gas or kerosene is described. Photographs illustrate the installation which was finally approved. The capacity of the heaters is 600 watts at 110 volts and the temperature to which the patterns are heated is approximately 90 or 100 deg. F. The use of the electric installation permits of easy regulation of temperature, and it is stated that the use of electric heat has been cheaper than the use of kerosene, besides being more satisfactory in other ways which are mentioned. Two heaters on a 16 x 11 x 2 in. plate had a total rating of 300 watts at 100 volts. This equipment is shown to be applicable to either squeezer or stripping plate machines.

* Abstract of a Paper read before the Rochester Meeting of the American Foundrymen's Association.

C

New Foundry of Messrs. James & Fredk. Howard, Ltd., Britannia Iron Works, Bedford.

The new foundry which Messrs. James & Fredk. Howard have recently put in commission at their Bedford Works is, so far as the floor space covered, a duplicate of the foundry laid down 35 years ago, and which the new foundry adjoins. It may be recalled that at the time the first foundry was started up it was one of the finest in the Kingdom, and even to-day it would compare very favourably with the majority of iron foundries up and down the country. But a walk from the old to the new foundry enables one to appreciate to the full the enormous strides which have recently been made in foundry design and equipment.

The new foundry, lofty, well lighted and well ventilated, is covered by two bays each 250 ft. by 100 ft., with an annexe down the one side 25 ft. in width.

The stocking ground bounds one side of the foundry and is served by both the Midland and North Western Railways.

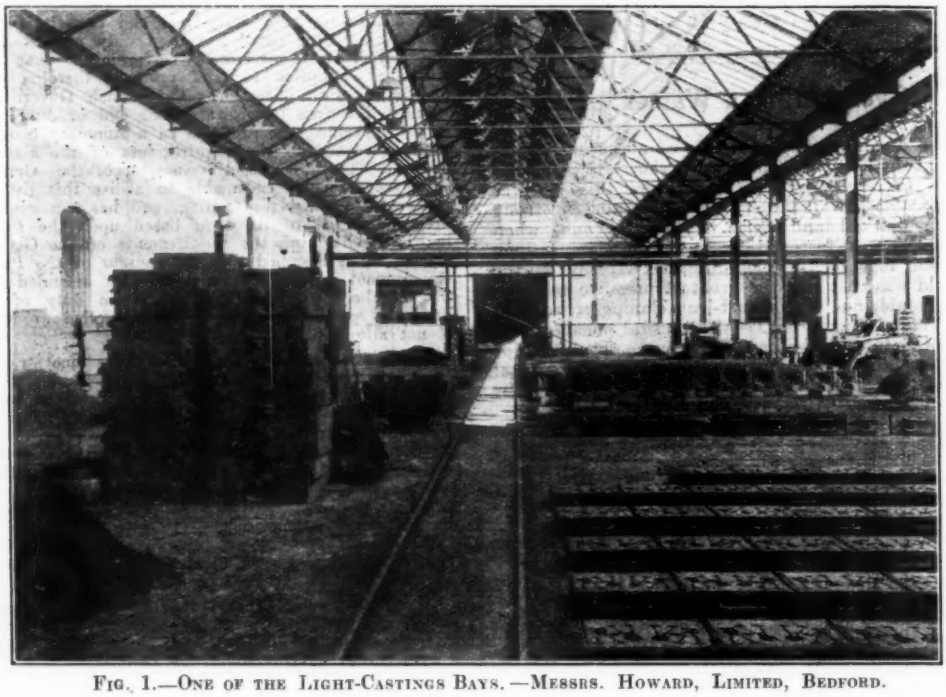

FIG. 1.—ONE OF THE LIGHT-CASTINGS BAYS.—MESSRS. HOWARD, LIMITED, BEDFORD.

FIG 2.—THE WHEEL-MOULDING BAY.—MESSRS. HOWARD, LIMITED, BEDFORD.

The melting plant comprises 4 cupolas, two each of 6 tons and 4 tons melting capacity respectively, and a 10-cwt. emergency cupola, supplied by the Constructional Engineering Company, of Birmingham. They have a common charging platform, 72 ft. by 25 ft., which is under cover and with a floor laid with iron plates. Material is conveyed

to the charging platform by two 15-cwt. electric hoists. One bay of the foundry floor is laid with concrete, whilst the floor of the second bay is covered with sand and laid with rails at 16-in. centres, for levelling up.

In the heavy bay there are two large MacDonald machines, a Tabor roll-over jar-ramming machine, and four Tabor squeezers. There is an almost endless range of light moulding machines, all repetition work being catered for by special machines the whole of which were designed and built by the company. A special store is devoted to these machines, and they are brought into the foundry as occasion may require. The advantage of this arrangement will be obvious, as it enables a large number of machines to be held in readiness for immediate duty, whilst only those that are actually in operation occupy the foundry floor.

The ladles for casting are conveyed by bogies.

In the annexe, the core shop occupies one end. This is provided with two August ovens, each 25 ft. by 12 ft. One of these ovens has been divided into three cells and provided with separate control, a very convenient arrangement for dealing with small work. In the non-ferrous casting shop, the melting plant installed includes two Morgan furnaces, each of 400 lbs., and two pot furnaces, each of 120 lbs. capacity.

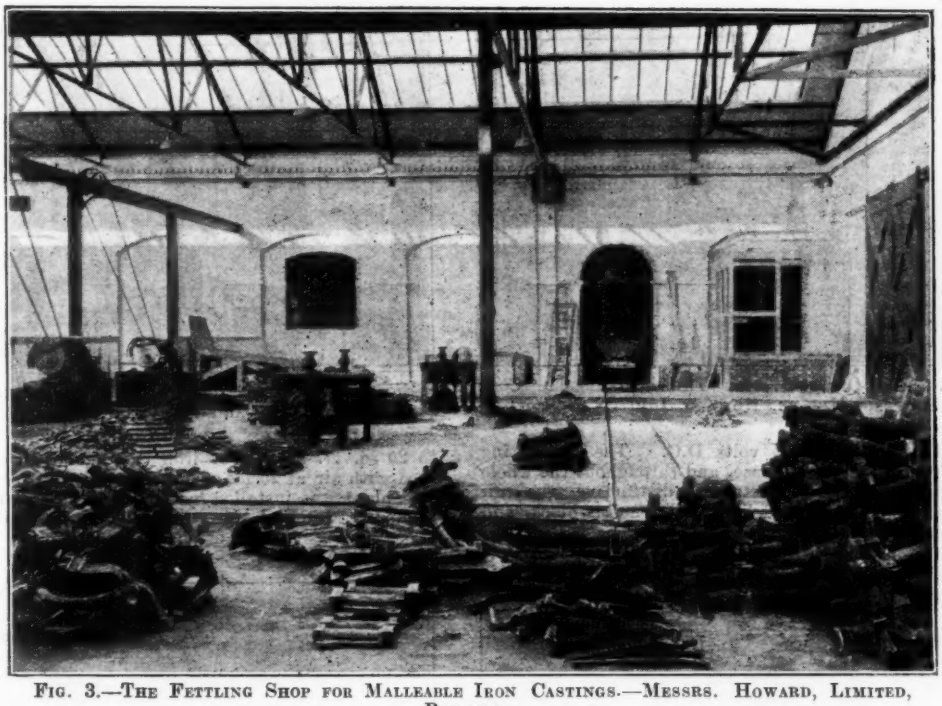

FIG. 3.—THE FETTLING SHOP FOR MALLEABLE IRON CASTINGS.—MESSRS. HOWARD, LIMITED, BEDFORD.

FIG. 4.—A CORNER OF ONE OF THE FETTLING SHOPS.—MESSRS. HOWARD, LIMITED, BEDFORD.

The centre position in the annexe is taken up by the foundry power house, the building and equipment of which is distinctly out of the ordinary in foundry practice. The floor is laid with concrete, and the walls are painted. The plant comprises two Keith-Blackman fans, which are driven by 45-h.p. variable speed motors, which are capable of delivering up to 10,000 cub. ft. of air per min. to the cupolas; one of these sets is a stand-by.

Two Alley & Maclellan compressors, each of

which delivers 150 cub. ft. per min. at 120 lbs., are driven by 33 h.p. motors, and supply power for the pneumatic tools, machines, etc., whilst two Tilghman's compressors, each driven by a 50-h.p. motor supply the sand-blast plant. The whole of the cables, etc., are readily accessible, being laid in culverts below the floor, which are covered with removable plates. Current is taken from the mains at 2,200 volts, and transformed to 220 volts D.C. The conducting pipes in the power house, and throughout the whole of the foundry, are made distinctive, the air mains being coloured blue, water mains black, and electric red.

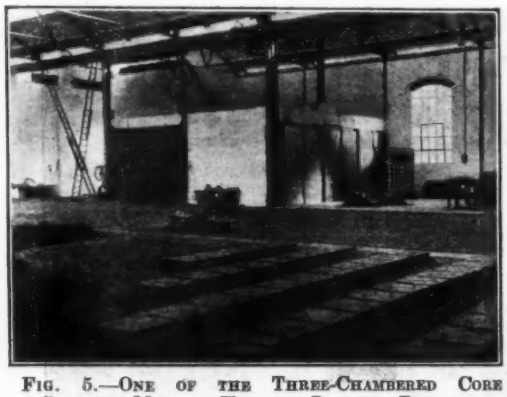

FIG. 5.—ONE OF THE THREE-CHAMBERED CORE STOVES.—MESSRS. HOWARD, LIMITED, BEDFORD.

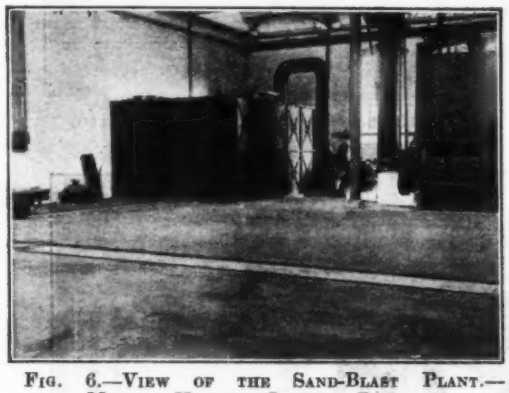

FIG. 6.—VIEW OF THE SAND-BLAST PLANT.—MESSRS. HOWARD, LIMITED, BEDFORD.

The arrangement of the sand-blast plant is, as will be seen from our illustration, particularly compact and convenient, whilst every component is within view and easily accessible. The sand-blast room is 15 ft. long by 12 ft. wide by 8 ft. 3 in. high. The walls are of strong cast-iron, and the room is provided with swinging doors at one end, and with sand-blast apparatus designed for two nozzles operating in the room. Installed on a pedestal is the exhauster for ventilating the room and lifting the abrasive into the cyclone separator, dust chamber, etc.

Alongside the room is a complete sand-blast tumbling-barrel plant, with a barrel 40 in. in diameter by 48 in. long. Two sand-blast jets, one each end of the barrel, are arranged for spraying the abrasive. The efficiency of the plant as a whole is remarkably good; each jet will clean 16 to 20 sq. ft. surface of iron castings when operated with air at 25 lbs. per sq. in. nozzle pressure. The plant was installed by Tilghman's Sand Blast Company, Limited, Manchester, and is in every respect representative of their latest practice.

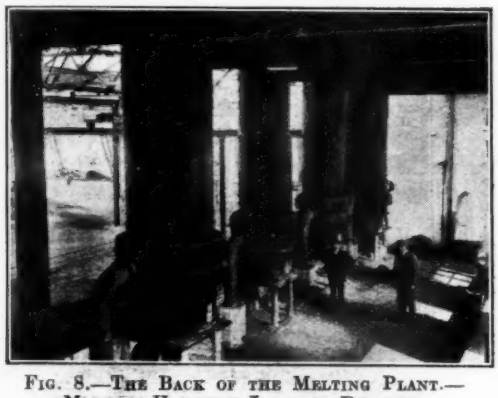

FIG. 8.—THE BACK OF THE MELTING PLANT.—MESSRS. HOWARD, LIMITED, BEDFORD.

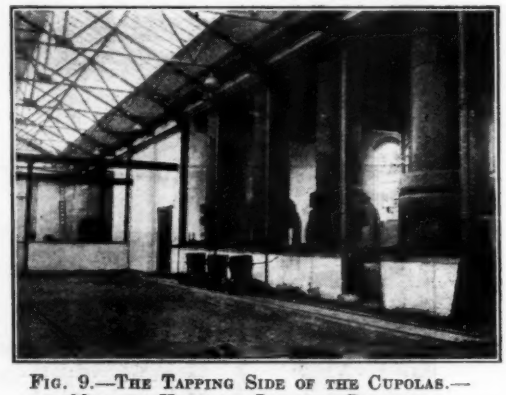

FIG. 9.—THE TAPPING SIDE OF THE CUPOLAS.—MESSRS. HOWARD, LIMITED, BEDFORD.

Fettling is done at the end of the foundry adjoining the sand-blast plant; in this department are also the dipping boshes for painting.

There are three large annealing furnaces within the foundry, and four similar furnaces are housed in a lean-to adjoining. The furnaces, which were built by the company, are of the recuperative type, coal fired, and designed to take a 5-ton charge.

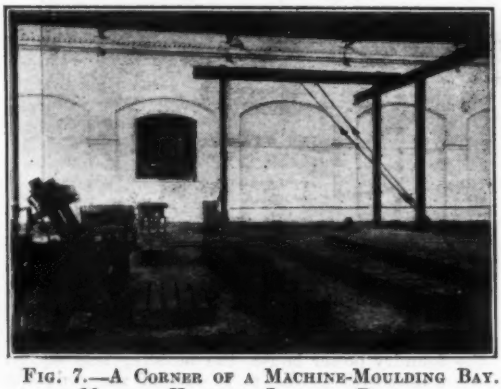

FIG. 7.—A CORNER OF A MACHINE-MOULDING BAY. MESSRS. HOWARD, LIMITED, BEDFORD.

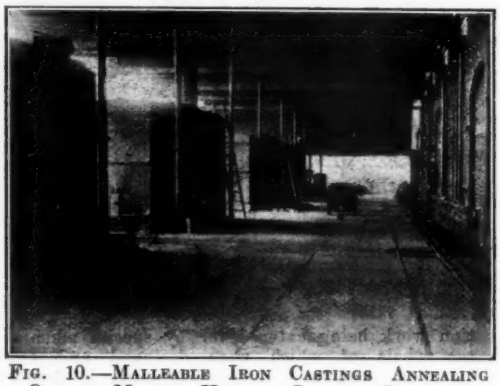

FIG. 10.—MALLEABLE IRON CASTINGS ANNEALING OVENS.—MESSRS. HOWARD, LIMITED, BEDFORD.

An Apprenticeship Course in Foundry Practice.—II.

By Ben Shaw and James Edgar.

MOULDING MATERIALS.

Just as timber is the primary patternmaking material so sand is the most important material used by the moulder, and success in the production of sound castings depends to a large extent on its correct composition. Despite its apparent weakness and friability, it has properties which, when its constituents are modified to suit specific classes of work, and metal mixtures are also considered, render it suitable for making moulds of the most delicate and intricate design and the largest size. It is well that the apprentice should appreciate fully the importance of correct sand composition.

Physical and Chemical Properties.

Moulding sand is refractory, and when moulded into almost any shape will not become decomposed and collapse before the inrush and pressure of the molten metal. This largely determines the value of a moulding sand, because the composition is changed by the high temperature of the metal. This applies particularly to that which forms the face of the mould. Sand is porous, to a more or less degree, according to its composition, and this permits the escape of air which, by expansion, is increased in volume owing to the sudden change in temperature, and of gases released by the molten metal.

Although suitable moulding sands possess these physical qualities, these are dependent to a great extent upon the chemical composition which must therefore be given some consideration. Moulding sand, in its natural condition, consists mainly of silica (SiO_2) and alumina (Al_2O_3), and in combination with these are lime (CaO), magnesia (MgO), iron oxide (FeO) and alkalies (potash—K_2O and soda Na_2O), which are in the nature of impurities, as they reduce the quality of the sand, according to the amount and composition of such impurities contained in it.

Refractoriness.

It is the silica or quartz in the sand which determines its refractoriness. This is the heat resisting element, and the higher the temperature of the metal for which the mould is to be prepared the higher should be the percentage of silica or quartz in the sand used, and, incidentally, the purer its form. The impurities contained in the sand have an important bearing upon its refractoriness, especially when they are fusible at a lower temperature than that of the molten metal to be used for the casting. Both soda and potash when present, form silicates at a comparatively low temperature, which fuse on the surface of the castings and reduce their value. Lime in particular is a very injurious component of sand, as it fluxes readily and is converted into slag by the heat of the metal, especially in the case of iron. Thus, although silica is the heat resisting element, it really depends largely upon the proportion of impurities the sand contains in determining its refractoriness.

Cohesiveness.

The alumina or clayey matter* in the sand, which is the binding substance or bond, gives that plasticity which renders it workable. It is also very refractory. It is known as the natural bond in the sand. The strength of a sand being determined by its clayey contents, thus, when the proportion of clay is very high, it is considered a strong sand in contrast to a sand low in clayey contents which is weak.

All sands which are used in their natural state are liable to variations in strength, and require to be strengthened or weakened according to the needs of the work for which they are to be used. The percentage of clayey matter contained in a moulding sand should be as low as will just give the requisite strength for maintaining the form given to it, in order that it may resist the momentum and pressure of the molten metal. An excessive amount of clay in a sand not only closes its texture, and reduces its porosity in consequence, but renders the mould sufficiently strong to resist the shrinkage of the casting, which may, in many cases, cause a rupture or produce strains in a casting which are a possible danger.

In the preparation of sands for intricate work, particularly with regard to cores, naturally bonded sands are not used to any great extent, because of the cost involved in the removal of the sand from the castings. The clay contents becoming baked prevents the disintegration of the sand, and it is not readily removed from the casting. To obviate this in many classes of work, especially repetition work, artificial bonds are introduced in sand mixtures, clay as a bond being either partially or wholly excluded. Those artificial bonds, as a rule, consist of carbonaceous substances such as linseed oil, molasses, resin, etc., as well as various compounds specially prepared for the purpose. They are more or less burnt out by the heat of the metal, and the sand, having its bond reduced, is more friable and loose and is easily removed from castings.

Porosity.

The texture of the sand determines the relative degree of permeability it possesses. As a rule a coarse-grained sand has a more open texture, and is more permeable than a close-grained sand, not because of any larger area of pore space it may have, but because the individual pores are larger and offer less frictional resistance to the escape of air and gases generated during the time of casting, in comparison with a sand of finer texture. Coarse-grained sands cannot, however, be faced with the same degree of fineness as those having a finer texture, unless some additional finishing medium is used to cover the surface of the mould; therefore sand is graded to suit the particular work for which it is required, and the permeability depends upon the mixture used for the mould, and, incidentally, upon the skill employed in its formation. Unless air and gases can escape freely, pockets and blow-holes are formed, the surface of the casting becomes scabbed, or the metal may be blown out almost as fast as it is cast into the mould. To reduce the possibility of making waster-castings from this cause, artificial means are adopted to aid the mould in the rapid release of gases. This is the method of venting, and will be referred to in future articles dealing with the manipulation of the sand in the making of moulds.

Varieties of Sand.

Large quantities of moulding sand of suitable varieties are easily obtained in this country, Erith, Mansfield, Birmingham Cemetery, Shropshire, Cheshire, Yorkshire, Falkirk, Clyde Valley Rock sand and Belfast red being but a few of the suitable sands obtainable. There are considerable differences in the character and quality of the various sands. Some are more refractory than others, while some contain a greater proportion of fusible impurities, which reduce their value for moulds that are to receive metal at a very high temperature. Some are strong and plastic in contrast to others which are weak. There is also considerable difference in texture not only among different sands, but also in different varieties of the same sand.

Facing and Floor Sand.

Mixtures, which are specially prepared in a pug mill in order to toughen the sand and increase its plasticity, are not used in the preparation of the whole of the mould, but merely to provide a facing for it against which the metal is cast. The major part of moulds are made up of black or floor sand, which serves as a backing or support for the facing sand. This floor sand has originally been specially mixed sand, but its contact with the molten metal, together with carbonaceous addi-

* Pure clay is Al_2O_3 2 SiO_2 3H_2O and is known as kaolin or china-clay.

tions to the mixtures has caused it to become either black or a much darker colour than it was originally.

Burnt Sand.

When metal has been poured against facing mixtures they lose their cohesive qualities to an extent depending upon the temperature of the metal. The clayey matter is burnt, particularly that which is in direct contact with the metal and its strength is reduced in consequence. This is known as burnt sand, and it mixes with the floor sand. Sand which has lost all its binding power is used for separating parts of the mould and is known as parting sand. Special parting compounds are prepared and sold for the purpose, but frequently the sand adhering to castings is preserved and passed through a fine sieve for use as a parting sand. This practice is more common in ironfoundries than in either brass or steel foundries, and it has a certain economic value.

Permanent Moulds.

The use of sands for moulds has one important disadvantage in that it necessitates the preparation of a new mould for every casting produced. This is a decided drawback when dealing with work of a repetition character and efforts have been made from time to time to prepare moulds of a suitable material, which will preserve its shape sufficiently to enable the casting of a quantity in it. Those are in the nature of permanent moulds, the expression being used in a comparative sense only. Metal moulds are prepared for this purpose, particularly for those metals which melt at a low temperature, such as zinc alloys, aluminium and even brass. Force is applied either by means of a plunger or by a considerable head of the metal, in order that the mould may be completely filled. These moulds are usually constructed of iron and entail considerable expense in their construction, great care and accuracy being necessary in assembling the mould, so that the casting made in it can be quickly extracted, directly the metal has solidified and without injury to either casting or mould. Owing to the elaborate nature of the moulds and the high cost of their production their usefulness is limited to small work for which hundreds of similar castings are required. The use of iron moulds is limited in its application for cast-iron, although they are used in casting the junction pieces of iron bedsteads. Metal moulds make the cast-iron hard and brittle. This action is somewhat mitigated by heating the mould and removing the casting directly it has solidified. They are used advantageously in the making of gaggers and soldiers, which are introduced into sand moulds for additional strength.

Moulds for Chilled Castings.

Moulds are frequently prepared for iron castings which consist of a combination of sand mould and iron mould. The chilling action on the metal caused by the iron mould gives the castings a very hard-wearing surface, and advantage is taken of this peculiarity for certain castings which require such surfaces. The tread on rail truck wheels, stone crushers, rolls, etc., are frequently treated in this way, a cast-iron mould being used for the part required to be chilled, and the remaining part of the mould consisting of sand. The metal moulds or chills, as they are called, are usually of heavy section to prevent fracture due to the heat, and also to absorb the heat from the molten metal quickly, and thus chill the casting. Sometimes chills are made hollow for water-cooling, and the surfaces to receive the metal are generally coated with some refractory material to prevent direct contact with the metal.

Plaster of Paris.

Moulds are also prepared in Plaster of Paris from which castings are produced, but these have special reference to the jewellery trade, although they are also employed to a certain extent in toy-making, for metals and alloys which have a low melting point.

Sand for Steel Moulds.

The sand used in steel moulding must be highly refractory, and have a very low percentage of fusible impurities. Its silica content should not be less than 90 per cent., and preferably more, according to the character and quality of steel to be poured. The size of the sand grains should be uniform. Yorkshire and Trent sands are among those commonly used for this purpose, but some foundries use a comparatively pure silica sand, adding the required amount of clay or artificial bond for their facing mixtures according to circumstances. It is the usual practice to make use of a certain amount of new sand in the facing mixtures, the amount varying according to its strength. In some instances, however, the silica sand is extracted from the sand mixture after it has been used, and the necessary amount of clay bond added to it before milling, to provide a new facing mixture. This method has economical advantages. For very large castings, when the moulds must withstand the intense heat for a long period, a special mixture known as "compo" (an abbreviation of "composition") is usually used. This consists invariably of old silica bricks, burnt ganister, usually from coke furnaces, broken crucibles, from which all flux has been removed, hard coke and special slate-quarry clay in varying proportions. It is milled with sufficient water to give it the consistency of lime, and when dried will resist the influence of very heavy sections of the molten metal without detriment.

Sand for Cast Iron.

While a larger percentage of fusible impurities can be tolerated in sands for cast-iron than for cast steel, they should nevertheless be low to obtain clean surfaces on the castings. Erith, Mansfield, Birmingham, Falkirk, Belfast red, are some of the sands used for iron. The proportions of new and old sand to form the facing mixture vary with the type of moulding, the character of the casting to be made, and the grade and strength of new sand used.

Sand for Non-Ferrous Metals.

As a rule sands which are suitable for moulds to receive cast-iron are also suitable for non-ferrous metals and alloys, and for such castings as are made in common brass or commercial aluminium, the same sand may be used over again without the special introduction of new sand in the facing mixture, the surfaces of the castings not differing appreciably.

Facings.

Quite apart from the facing sand mixtures which may be used for the different forms of moulding, special facings are frequently used to give a good skin to the castings and to cause the sand to peel from them more readily. They are either dusted on to the moulds or applied as a wash or paint. Moulds for steel castings are generally dusted with flour-silica, or a combination of flour-silica and graphite, when a dry facing is used, and silica paint if a wet facing is preferred. The latter is simply flour-silica mixed with water to the consistency of cream, to which a bond has been added, so that the facing will adhere to the mould when the moisture has been evaporated from it. Steel moulders' compo. is sometimes thinned with water and applied as a wash or paint in heavy work.

Graphite is more frequently dusted as a facing where desirable for cast-iron, although coke dust and charcoal are also used. It is preferable because a good surface can be worked on the mould. The wet facing for this work is generally referred to as a blackwash, and consists of a mineral carbon to which a bond is added and mixed with water. The quality of the blacking used is important in obtaining a satisfactory face on the casting.

The need for these special facings is not as important for metals and alloys having low melting temperatures, but when a particularly good surface on the castings is desirable, either dry or wet facings are applied according to the type of moulding. Flour is frequently used to dust on moulds for brass, but graphite and soapstone* are equally as good (also known as talc) especially for heavy work, and they sleek much better. Either graphite or soapstone or both combined bonded and mixed with water are suitable as a wet facing for brasses and bronzes. This is equally applicable to moulds for aluminium, but dusted soapstone or French chalk are usually preferred, when a facing is considered to be necessary.

* Soapstone, Talc and French Chalk are all varieties of hydrated Silicate of Magnesia.

American Methods of Manufacture of Malleable Iron Castings, and Some Data in Connection with the Finished Product.*

By Enrique Touceda (Albany, New York).

(*Continued from Page* 53.)

The Reverberatory Furnace.

The reverberatory, or air furnace as it is called in the States, is the melting apparatus mostly used for the production of white-iron castings. It is, as is well known, a very wasteful apparatus, having an efficiency ordinarily under 10 per cent. As numerous inquiries have been received in regard to its design the following remarks will prove pertinent. Under the assumption that bituminous coal and forced draft are to be used and that the furnace capacity is to be 15 tons, the first dimension to establish and lay-off is the length of hearth, that is, the inside distance between bridge-walls. Theoretically this should be of a distance such that the charge will have absorbed all of the heat from the combustible gases just as these leave the hearth on the way to the stack. Such conditions are impractical, for this would imply an exceedingly long, narrow hearth with depth of metal so shallow that it presumably would be oxidised badly long before it became hot enough to pour. In order to obtain practical working conditions, therefore, the distance between the bridges must be such that a proper ratio of width, length of hearth and depth of bath must obtain, the former to provide for a workable hearth-size and the latter to avoid excessive oxidation. For this capacity furnace an inside distance between bridges of 22 ft. and an inside width of 6 ft. 6 in. will provide a mean depth of bath of 7 in., which will be about right. The top of the front bridge theoretically should be level with the molten metal, but if this were the case the furnaceman in rabbling the bath to hasten the melting of pig still partly solid and protruding above it would splash molten metal into the fire-pot. To prevent this the bridge should be some 6 in. higher than the level of the metal after the charge has entirely melted down. The top of the rear bridge should preferably be 3 in. lower than the top of the other. In order to lay off the hearth bottom, draw a horizontal line 6 in. below the top of the front bridge, which will hit the rear bridge 3 in. lower than its top. Draw another horizontal line 9 in. under this, and between these two lines, and limited by the bridge walls, lay off the bottom on a curve such that its lowest point, locating the tap hole, will be about 8 ft. from the front bridge. This is shown in Fig. 1. The curve or slant on each side of this point should have a pitch not much more than sufficient to drain properly the iron from the hearth, and such that as the metal is withdrawn, feathered edges of metal are not pronounced, that is, the average mean depth of metal should be as great as possible when the hearth is full, and as it is being emptied. A tendency is to get the tap hole too near the front bridge. If this is done the brick surrounding the tap hole will wear unduly, owing to the wash of the metal and slag produced by currents induced by the action of the overhead blast used to provide air for secondary combustion. Next lay off the thickness of the bridge top which we will place at 15 in. Theory calls for the level of the coal bed to be flush with the top of the bridge, but if this were done, the forced draft would blow some coal into the hearth and recarburise the bath, which is particularly a matter that it is desirable to avoid.

For the general character of coal used in the States, it has been found that if the distance from top of bridge to the level of the coal is 15 in., there is little danger of this happening, which distance also will locate the bottom of the fire door or stoke hole. The next step to decide upon is the depth of fire bed, bearing in mind the fact that the use of bituminous coal is actually equivalent to the employment of two separate and distinct fuels: one consisting of coke and the other of gas. For this reason it has always been the writer's practice to approach as near to gas producer principles as possible, not only for the sake of economy, but for subsequent uniformity of operations as well. In his designs, therefore, he has provided for a deep bed of fuel. In the case of a thin bed, the burning of the fixed carbon left after the volatile matter has been distilled off, serves to heat the fire pot intensely and locally rather than the hearth where the heat is desired, while it has been the writer's effort to discourage this action and bring about as little combustion in the fire pot and as much in the hearth as is practically possible. If the fixed carbon on the grates can be converted into CO, then this combustible gas can be burned in the hearth, and we are transferring carbon from a location where its combustion does minimum good to the place where it is of maximum benefit. For this reason if a thin bed of fire is to be used, the percentage of volatile matter in the coal should be as high as possible, while in the case of a thick bed the volatile matter should preferably not exceed 25 per cent. It happens, also, that through this procedure another thing is accomplished of equal if not of more importance. Volatile matter is not driven off of bituminous coal at a uniform rate. When such coal is stoked on a thin fire consisting of a glowing bed of fixed-carbon or coked-coal at a very high temperature, the gas instantly surges from the added coal in great volume. Inasmuch as no means has been found whereby the blast valve for the secondary air can be adjusted to deliver an amount at all times in theoretical proportion to produce complete combustion with the amount of combustible gas passing over the bridge, the following undesirable condition obtains:—The instant the stoker fires, more combustible gas is passing over the bridge than properly can be taken care of by the fixed amount of secondary air, provided the air supply as it should be is fixed for the average amount of combustible gases passing over the bridge from the time the stoker fires until it is time for him to fire again. This state of affairs lasts for a short interval of time, when for some moments there will be about the theoretical proportion of combustible gas and air, after which the air will be increasingly in excess until the stoker again fires. It is plain that if the amount of secondary air must of necessity be fixed, the more uniformly the combustible gas is evolved the less serious will be this handicap.

While there appears to be no practical method of accomplishing this object, the condition can be improved if arrangements are made whereby the fixed carbon of the coal is converted to CO, which will serve to transfer the carbon where its combustion serves but little good to the hearth where it is badly needed. Not only will this occur, but it will, at the same time, better the unbalanced condition referred to, because there will, at all times, be a more constant supply of combustible gas passing over the bridge in a unit of time.

In order still to better control the situation the stoker should be instructed to fire a small amount of coal at frequent rather than a large amount at longer intervals of time. Since the level of the coal has been placed 15 in. below the top of the bridge, a distance 30 in. lower will give the location for the top of the grate bars, while an additional 30 in. will provide sufficient height for the ash pit. Since the width of the grate is established by the width of the furnace hearth, it remains to determine what should be its longitudinal dimension. This obviously will depend upon the number of pounds of coal it is essential to burn per sq. ft. of grate per hr. Experience has demonstrated that for this size furnace a grate area of about 36 sq. ft. will prove to meet the conditions required, which is a compromise as between economy and speed.

* This Paper was the American Foundrymen's Exchange Paper, and was read before the Birmingham Conference of the Institution of British Foundrymen.

Consequently if 5 ft. 6 in. is taken as the longitudinal length of the grate the area required will be obtained. If this distance is added to the other longitudinal distances cited, the total length from inside edge of rear bridge to inside of wall of fire pot will be obtained.

If this design were being laid out on paper as in Fig. 1, a perpendicular line of indefinite length should be erected at the latter point, the proper length of which will be determined subsequently by its intersection with the roof line. In order to determine the lines for the furnace roof curve, at a section passing through the longitudinal axis of furnace, it is essential to establish three points

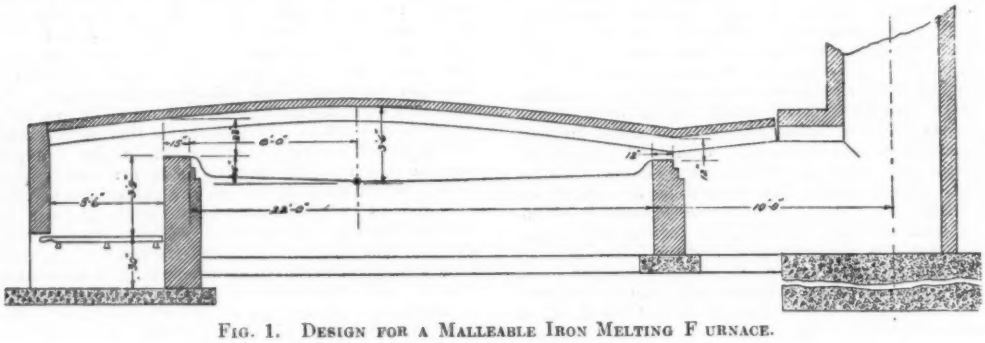

FIG. 1. DESIGN FOR A MALLEABLE IRON MELTING FURNACE.

only. First, the perpendicular distance above the front bridge; second, the highest point in the roof, which is usually directly over the tap hole; and the last, the distance above the rear bridge. For this capacity furnace the first point should be about 23 in.; the second will depend upon the character of castings to be made, and for average conditions would be 42 in. If they are light the distance should be greater than if they are heavy, for in that case the sprue will occupy more room per ton, while the distance for the last point should be about 12 in. As the melting is chiefly accomplished by reflected heat from the roof it is desirable to have it as close to the bottom as possible and still admit of the placing of the charge in the furnace conveniently and rapidly. After locating these three points, on the paper, an easy curve can be drawn through these points with a flexible rule, taking the precaution of bringing the end of the curve that intersects the extreme wall of the fire pot as low as judgment indicates will not prove abnormal, in order to restrict the space in the fire pot, with the result that combustion will be discouraged in that compartment as much as possible, and combustion forced to take place in the hearth.

All the inside lines needed for a longitudinal section up to the hearth side of the rear bridge wall have been obtained. It will be sufficient if the top of the rear bridge be 12 in. wide, which in the direction of the stack can be stepped off in accordance with usual construction. The distance between the rear bridge and the stack is called the neck of the furnace, and while its length in no way affects combustion it should be sufficiently long to prevent the rapid burning away of the lining of the stack as it is cheaper to repair the former than the latter. A distance of 10 ft. from rear bridge to stack centre will prove to be about right. Obviously with forced-draft, the stack requirement need be provided only for what is essential in order to prevent the smoke from proving a nuisance. The side-wall linings are usually 18 in. thick. The furnace is enclosed by iron plates, held in place by buck stays, conveniently spaced.

While there are many designs of bung-frames, the one favoured by the author consists of a 6-in. eye-beam, bent for a centre spring of 8 in., with clamp castings on the ends, that are hinged at a hole in the lower part of the web by means of a bolt that goes through this hole and one of equal diameter in the casting as shown in Fig. 2. The part of the casting that extends below the eye-beam to clamp the brick is provided with a knife edge, and a steel plate is placed between it and the first brick for a uniform distribution of pressure. Through this construction a heavy pressure can be applied to the bricks that will keep them securely in place, and not only is a very strong and stiff bung-frame provided, but as the webs are narrow a considerable part of the brick is left uncovered which will allow of heat being radiated off sufficiently fast to prevent damage to the roof. Another very good form of frame is shown in the design for a 20-ton furnace. (Fig. 3.)

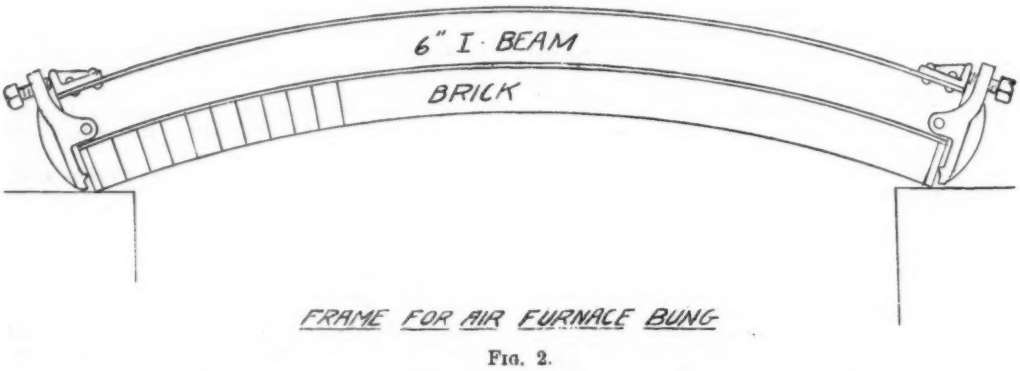

FIG. 2.

Construction of Hearth.

While for the most part the ordinary fire-sand bottom is used in this country, the author favours the brick bottom, which can be made of old bats that otherwise would be taken to the dump or ground up for other use. The brick should be laid on edge on a cushion of fire sand about 2 in. deep, and spaced about ⅛ in. apart on all sides. A very dry fire-sand, having enough impurity, in the form of bases, to flux tightly with the brick then should be poured into all the crevices, after which more sand should be thrown on the surface, and this swept around by means of a stiff road-cleaning broom, until every crevice is completely and tightly filled with sand.

A bottom laid in this manner can be relied upon to give much longer life than the regular bottom of fire sand.

The Tuyeres.

The tuyères should be located about a foot in front of the grate bridge, and inclined at an angle of about 45 deg. While the general practice

is to use from four to six pipes for tuyères, the author prefers the continuous type that goes practically across the roof, which, instead of jets, delivers a thin sheet of air that cuts and completely mixes with the stream of combustible gases passing into the hearth. The ends of this continuous tuyère should be constructed so that the air will not impinge upon the side walls in order to prevent the erosion that would otherwise follow.

A direct connected motor-driven fan installed at the side of the furnace will prove to be more economical than one that is belt-driven and located at a rather distant point necessitating somewhat lengthy piping, while it is better practice to have a separate fan for the secondary air supply, as through this means both the volume and pressure can be better regulated. About 120 cub. ft. of air per lb. of coal seems to give good results for under grate supply, rate of oxidation and other factors being considered, and about one-third of this amount provided for secondary air supply. While only a few of the plants at the present time make use of a CO_2 recorder, gradually the wisdom of using this instrument more generally is being recognised.

tion has been slow. It should also be stated that, once the fire pot has been filled, it is a mistake to allow the stoker to disturb it except to level the bed. He seems to be obsessed with the belief that, if he is not continually poking the fire, he is remiss in his duty, in spite of the fact that this method of procedure will result in the formation of clinker, making the conditions worse in a coal that has that tendency, and inviting the trouble in one that has not. While various types of automatic stokers have been tried, none has given satisfaction.

Oil and Powdered Fuel Firing.

In some instances where the cost is not prohibitive, oil is used for fuel, and in other cases powdered coal. An average of 58 gall. of oil per ton of iron melted and a ratio of 4.5 of iron per ton of coal used, can be counted upon in the case of good installations, as against an average ratio of 2.5 of iron to one of coal in the case of regular air-furnace practice. The installation for oil is very inexpensive as compared with that for powdered coal, unless provision is required to safeguard against strikes or for other causes that would necessitate a very large storage capacity. In the case of powdered coal, its adoption by a plant of small capacity would be prohibitive, unless it was the intention to use this system for annealing also. Where conditions warrant, powdered coal is the fuel to use, due to its flexibility; but, if installed, provision should be made whereby it is not essential to run the entire installation in the event that the plant is running on quarter- or half-capacity.

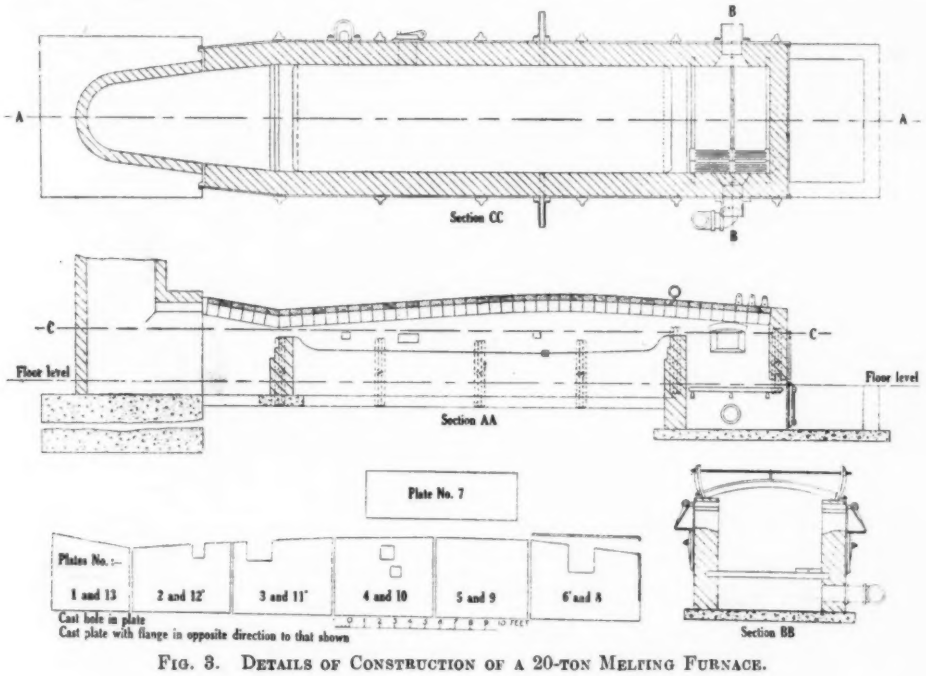

FIG. 3. DETAILS OF CONSTRUCTION OF A 20-TON MELTING FURNACE.

Grate Bars.

If a deep bed of fire is to be used it is quite essential to have properly designed and spaced grate-bars. If the grate does not shed ashes with facility, the stoker will shortly find that instead of a deep bed of coal he has a deep bed of ashes, with the result that little if any CO will be generated, while if the bars are too widely spaced, a happening that is less frequent, the bars quickly will be destroyed and trouble will be experienced from clinker with a coal that would not perhaps cause that annoyance under other conditions. The author has designed a grate-bar of kite-shaped section, as a stiff bar can be made in this manner that will produce but minimum clogging as compared with rectangular bars of equal depth. It is plain, that as soon as ashes are deposited on such bars, they must either fall through with facility or clog only as far down as one-third the depth of the bar, which is the distance at which the kite-section is of maximum width. Beyond this depth the section gets narrower and the space between the bars wider, and consequently the ash must fall free from this point down. The ends of the bars where they rest on the grate bar supports are of rectangular shape, the dimensions depending upon how far apart the bars are to be placed; these ends being proportioned to act in part as spacers. While certain forms of the shaking grate have given satisfaction, their adop-

(To be continued.)

New Japanese Railways.—According to an official report recently published, the privately-owned railways in Japan, which now number 152, and have a mileage of 2,160 miles with an authorised capital of Yen 316,000,000 (say £34,000,000), are to be greatly increased. The new lines, which are to be built soon, the construction plans having been passed by the Government, number 87. The mileage is 1,029 miles and the capital Yen 77,027,000 (£8,300,000). There are, moreover, 102 railways which have been authorised, but have not yet completed their construction plans. The projected mileage of these is estimated at 1,364 miles and their authorised capital is Yen 216,560,000 (£22,500,000). When all these lines are completed the number of private railways in Japan will reach 341, with an authorised capital of Yen 610,072,000 (£64,000,000). The total mileage will be 4,554 miles, in which Yen 638,670,000 (£67,000,000) will have been sunk.

The Development and Manufacture of High-Tenacity Brass and Bronze.*

By O. Smalley, M.Inst.M. (Newcastle-on-Tyne).

(*Continued from page* 49.)

Aluminium Brasses.

Manufacture.—The copper was first melted under charcoal, the necessary additions of aluminium made with slick aluminium and the zinc worked in last. The whole was well stirred, introducing a little salt from the bottom of the pot, and allowing to remain in the furnace until the desired temperature had been reached, this usually taking from 5 to 8 mins. The pot was withdrawn, the temperature measured with a Pt.-Pt.-Rh. thermocouple and cast at the predetermined temperature.

From the point of view of practical utility 1.0, 1.5, 2.0, 3.0, 4.0, 4.5, and 5.8 per cent. of aluminium were chosen as the most suitable quantities. These were decided upon from a series of exploratory casts, when it was found that 1 per cent. Al. equalled approximately 5.6 per cent. Zn. in its effect on the general physical properties. For example, a 70 per cent. Cu.-26.5 per cent. Zn.-3.5 per cent. Al. brass possesses the principal features of ordinary Muntz metal; a 70 per cent. Cu.-24.2 per cent. Zn.-5.8 per cent. Al. brass somewhat similar features to a 53/47 *id est*, all "beta" brass. Likewise a 59 per cent. Cu.-39.67 per cent. Zn.-1.33 per cent. Al. brass appears to be equivalent to 70 per cent. Cu.-24.4 per cent. Zn.-5.8 per cent. Al. brass or to a 53/47 brass and so on. These equivalents have also been worked out by Guillet from their structure, and his figure of 6 is in fairly close agreement with the above.

The physical test results obtained from the large scale alloys are embodied in Table II.

Chill Cast.—Prominence is given to the remarkable effect of small quantities of aluminium in increasing the yield point and the strength of both 70/30 and 59/41 brass, which is accompanied by a corresponding fall in ductility and shock-resisting properties. Thus alloy No. 9 which is structurally equivalent to a 59/41 brass possesses the strength of mild steel and a remarkable resistance to dynamic stress. Above 3.5 per cent Al. the ductility of a 70 per cent. Cu-base alloy rapidly falls, and at 5.9 per cent. Al. when only the "beta" constituent exists, a high strength is obtained but little ductility.

In the 59/41 series, 1.35 per cent. seems to be the rapid strengthening limit of aluminium, although the maximum strength is not reached until 3.0 per cent. has been added. Exceeding this amount the strength steadily falls away, and on the inception of the "gamma" constituent the alloy loses its commercial value.

After forging, alloys 9, 10, and A1, which are essentially "alpha-beta" brasses show an all-round improvement in ductility and shock-resisting properties, and possess a wide range of combined strength and ductility.

In the ordinary way "alpha-beta" Al. brasses do not present any difficulties in working, and may be forged, rolled or extruded as readily as Muntz metal. Their increased hardness, however, demands a relatively greater blow or pressure in working, and readily hardening up cannot be worked down to small sections with the ease of Muntz metal.

All "beta" aluminium brasses suffer from a long period of heat fragility regardless of their

TABLE II.

No.	Actual composition. Cu.	Zn.	Al.	Mn.	Fe.	Physical condition.	Y. P. Tons per sq. in.	M. S. Tons per sq. in.	E. Per cent. on 2 in.	R. A. Per cent.
9	69.79	26.67	3.54	Nil.	Nil.	As cast	13.60	29.30	26.00	27.60
						As forged	23.40	37.10	34.00	41.90
10	69.13	26.32	4.55	—	Trace.	As cast	17.6	31.9	8.0	11.7
						As forged	20.3	38.6	17.00	20.00
11	69.42	24.68	5.90	—	—	As cast	28.10	38.00	3.00	1.50
						As forged	32.50	42.30	6.00	8.40
A.1	59.48	39.52	1.00	—	—	As cast	14.80	32.00	30.00	33.50
						As forged	11.10	31.30	41.00	44.60
A.2	58.35	40.11	1.54	—	—	As cast	16.4	35.20	17.00	18.50
A.3	58.26	38.56	2.18	—	—	As cast	16.00	36.40	16.00	21.50
						As forged	11.70	37.40	27.00	33.50
A.4	59.85	37.13	3.02	—	—	As cast	22.30	42.00	18.50	21.50
						As forged	19.00	40.3	24.50	30.60

No. 11 showed 133 crystals per sq. cm. as cast and 2,430 when forged.

TABLE II.—continued.

No.	Tensile Fracture.	Impact No.	Fracture.	Izod impact No.	Brinell hardness No.	Sclero-scope hardness. No.
9	Oblique silky. Elongation uniform over the 2 in. parallel. Trace of inter-crystallinity.	101	Fine, stony, semi-vitreous, silky edges.	—	104	—
	Fine, silky oblique, necked	91	Ditto. ditto.	—	143	—
10	Coarse crystalline, stony, defective (sand contamination).	33	Mixed crystalline and granular, free fron lustre.		134	32
	Uneven, coarse crystalline, stony, sound	51	Ditto. ditto.		143	34
11	Coarse crystals. Free from lustre. T'ce. of inter-crystallinity along the 2 in. parallel.	13	Very coarse, crystalline, crystal grains free from lustre.	—	185	—
	Coarse, stony, crystalline. Inter-crystalline along the 2 in. parallel.	25	Coarse, crystalline, inclined to be lustrous.	—	193	—
A.1	Coarse, stony, and accicular. Trace of inter-crystallinity along the 2 in. parallel.	46	Fine, stony, vitreous	40	114	21
	Fine, stony. Free from inter-crystallinity ..	67	Fine, stony, semi-amorphous	41	104	18
A.2	Coarse crystalline	23	Coarse, crystal, stony ..	—	129	21
A.3	Coarse crystalline, high lustre	25	Coarse crystalline, stony ..	—	138	22
	Coarse crystalline, lustre	39	Coarsely crystalline, strongly laminated.	—	143	23
A.4	Coarse crystalline, high red lustre	27	.. ..	—	159	25
	Highly crystalline. Brilliant red lustre. Presence of slight inter-crystallinity along the 2 in. parallel.	41	Fine, stony, inclined to exhibit inter-crystallinity.	—	154	23

No. 11 showed 133 crystals per sq. cm. as cast and 2,430 when forged.

* A Paper read before the Birmingham Conference of the Institution of British Foundrymen.

chemical composition. There is, however, no difficulty in working them hot, although the range of temperature permissible is limited. Ordinary "beta" brasses of the Cu.-Zn. series have a period of heat fragility extending from 315 deg.-455 deg. C.; "beta" brasses of the Cu.-Zn.-Al. series approximately from 226 deg. to 558 deg. C.

In the "beta" alloys under consideration, forging was performed between 700 deg. and 620 deg.C. They may be worked safely at temperatures above 700 deg. C., but there is great danger in doing

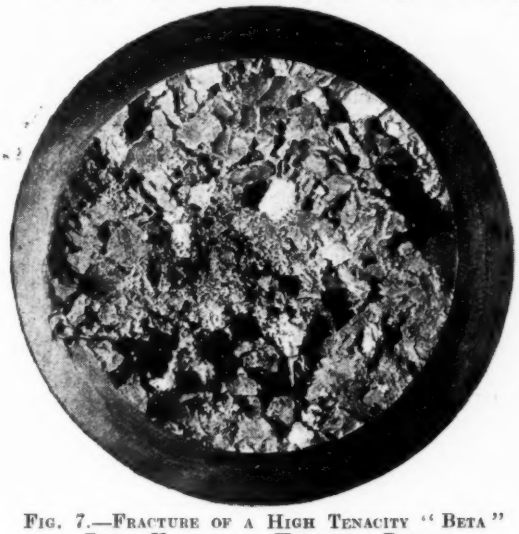

FIG. 7.—FRACTURE OF A HIGH TENACITY "BETA" BRASS VALVE ON A HYDRAULIC PRESS.

so owing to the abnormally rapid crystal-growth at such temperatures, which is not readily eliminated by a continuance of the work at lower temperatures. At the best, high tenacity "beta" brasses are brittle alloys, and slight overheating renders them unsafe in use. An instance of this may be cited in the form of a stop-valve for a hydraulic compressor, which gave serious trouble in service. These valves were made to the following chemical composition:—Cu., 59.0; Zn., 36.5; Al., 3.0; Mn., 1.5; and Fe. and Pb., less than 0.2. A tensile test showed that it had a strength of 39 tons per sq. in., and an elongation of 15 per cent. on 2 in.

Fig. 7 illustrates the fracture of one of these

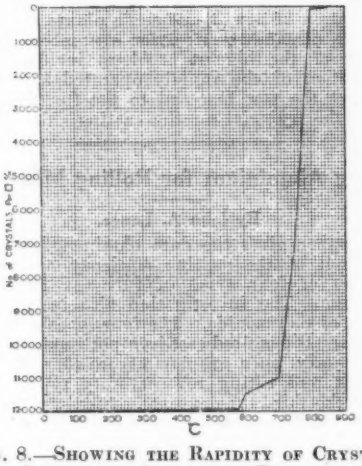

FIG. 8.—SHOWING THE RAPIDITY OF CRYSTAL GROWTH OF ALUMINIUM BRASSES.

valves, and is typical of many which collapsed in service, although each passed the specified physical tests. Alternating impact tests taken from some of the defective valves ranged between 7 to 10 blows, and the Izod 6 to 10-ft. lbs., figures which are more or less expected from the appearance of the fractures.

An inquiry into the method of manufacture showed forging to have been performed between 800 deg. C. and 720 deg. C., allowing to cool off on the floor. Forging the ingot at 700 deg. C., overcame this difficulty, and the following is the average physical tests obtained from some of the valves subsequently made:—

Yield point, 21 tons per sq. in.; maximum stress, 43 tons per sq. in.; elongation on 2 in., 26 per cent.; reduction of area, 34 per cent.; alternating impact number, 48; and Izod, 27-ft. lbs.

Fig. 8 gives some idea of the effect of temperature on the rapidity of crystal growth of aluminium brasses.

Microstructure.—Figs. 9 and 10 depict the effect of substituting 1.0 per cent. and 1.5 per cent. Al. for the same amount of Zn. in a 59 per cent. copper-brass. They amply demonstrate the co-efficient of equivalence previously referred to, and explain hardening propensities of Al.

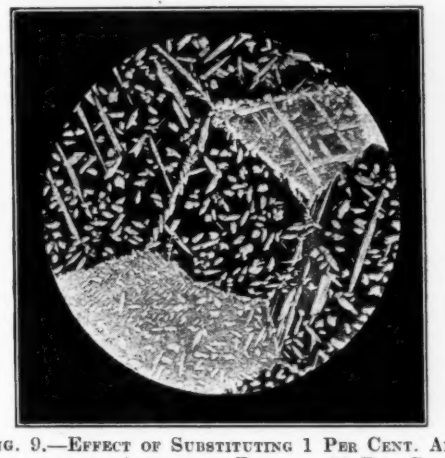

FIG. 9.—EFFECT OF SUBSTITUTING 1 PER CENT. AL. FOR SAME AMOUNT OF ZN. IN A 59 PER CENT. COPPER-BRASS.

Manganese Brass.

Manganese may be introduced by means of an 80 per cent. Mn., ferro-manganese, or 30 per cent. Mn., cupro-manganese. The common objection to the former is its high melting temperature and its association with 5 per cent. to 6 per cent. carbon which renders alloying difficult. The principal trouble arising from the use of Fe.-Mn., apart from these difficulties, is the inability to control the chemical composition of the finished alloy and the formation of intensely hard metallic pellets, which pellets not only create serious trouble in

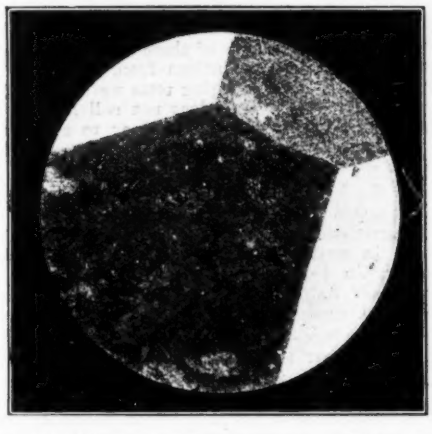

FIG. 10.—EFFECT OF SUBSTITUTING 1.5 PER CENT. AL. FOR SAME AMOUNT OF ZN. IN A 59 PER CENT. COPPER-BRASS.

machining but adversely affect the mechanical properties. This latter defect has been encountered in castings made by various foundries, and in every instance a chemical and physical examination proved the trouble to be unalloyed Ferro-Mn. The use of Cupro-Mn. by no means ensures freedom from this defect; it is no uncommon thing to find lumps of undissolved Ferro-Mn. in Cupro-Mn. alloys, unless skilfully prepared.

Commercial Cupro-Mn. is best made by first melting the Cu. under a slag consisting of 1 part broken glass, 1 part fine silica sand, and 1 part borax, stirring in molten Ferro-Mn. a little at a time. The whole should then be brought to a

good temperature, a little phosphor-copper added (0.03 per cent. P. calculated), again well stirred, skimmed and cast. Obviously special care is needed in the preparation of this alloy. If the Cu. and Ferro-Mn. are melted together there is always the danger of some few specks of undissolved Ferro-Mn. remaining, which are quite sufficient to cause trouble. The use of a protecting flux is necessary, or the melting losses are high, a hard, rich Mn. crust forming on top of the melt. Cupro-Mn. may be prepared also from pure Mn. and Cu. or by the aluminium thermit process. The former is costly, the latter unreliable, and there is no advantage from these expensive methods, if due precautions are taken in the alloying of Ferro-Mn. and Cu.

In the following examples the Cupro-Mn. of the composition shown in Table I. was used throughout. The Cu. and Cupro-Mn. were melted together under charcoal; Zn. was then worked in, introducing a little common-salt when the desired melting temperature had been reached in the furnace. The casting temperature was controlled pyrometrically.

Considered as a Zn. replacing element 1.0 per cent. Mn. is equivalent to about 0.8 per cent. Zn. Such a comparison, however, is of little value, the function of Mn. lying in other directions.

Details of compositions and physical test obtained are embodied in Table III., showing 1.0, 1.5, and 2.0 per cent. to exert, very little influence

TABLE III.

Series No.	Composition. Cu.	Zn.	Mn.	Fe.	Si.	Physical condition.	Y. P. Tons per sq. in.	M. S. Tons per sq. in.	E. Per cent. in 2 in.	R. A. Per cent.
M.1	58.95	39.72	1.01	0.24	0.08	As cast	10.1	25.1	51.0	49.7
						As forged	10.1	26.1	47.0	57.0
M.2	58.42	39.80	1.48	0.25	0.05	As cast	8.9	26.0	49.0	61.5
M.3	58.42	39.25	2.00	0.28	0.05	As cast	9.1	26.9	45.0	52.7

TABLE III.—continued.

Series No.	Tensile Fracture.	Alternating impact No.	Fracture.	Brinell hardness No.	Scleroscope hardness No.
M.1	Fine, stony, semi-cup and cone	59	Fine, silky, slightly vitreous in appearance in the lower half.	80	13
M.2	Fine, stony, silky edges, semi-cup and cone	— 74	.. ..	— 90	— 14
M.3	Fine, stony, semi-cup and cone, silky edges ..	68	As M.2, but more crystalline	90	14

on the tensile test, although both strength and ductility are slightly improved.

Owing to the similarity of these three alloys, and showing no marked variations from the ordinary standard 59/41 brass, forging tests were conducted on alloy M.1 only. This does not call for special comment, and Mn. does not appear to affect the hot working properties.

The value of Mn. as a deoxidant lies in its ready affinity for oxygen. When introduced in quantities in excess of that necessary to de-oxidise, its ready oxidation is responsible for considerable trouble in casting, and special precautions are necessary in temperature control and method of pouring, or exfoliation of oxide will be encountered, and cause much defective work.

Microstructure.—Under the microscope both M.1 and M.3 appear to possess the structure of ordinary 59/41 brass, although a notable reduction in the size of primary crystal grains is evident, and also indications of a better cohesion between adjacent grains, which suggests Mn. to be of value as a toughener. This assumption appears to be substantiated by the impact test figures obtained from alloys M.1, M.2 and M.3.

(To be continued.)

RUSTON & HORNSBY, LIMITED, Lincoln, have received an order from the Public Works Department, New Zealand, for two exceptionally large dragline excavators, mounted on caterpillar travelling gear, and fitted with 65 ft. jib and bucket of two cubic yards capacity. Strong competition was experienced from the American makers of excavating machinery. A further contract has also been received for a No. 10 crane navvy mounted on caterpillar travelling gear, with 1½ cubic yards bucket for the new Plymouth Harbour Board, New Zealand.

Recent Progress in the Open-Hearth Process.

By WILLIS MCKEE, of Arthur G. McKee & Co., Cleveland, O.

While slight improvement and larger units of open hearth steel furnaces have been made since the introduction of the process, probably no process in steel making has undergone so little change. The fundamentals have remained the same, the time of melting and the fuel economies having been improved but very little. A careful test run at the Homestead Steel Works proved that their losses due to temperature of escaping gases, radiation, conduction and other causes amounted to 95.77 per cent. of the heat units supplied by the combustion of the incoming fuel. The author cites the rather startling conclusion that if all losses could be eliminated there would be only about 20 to 30 lbs. of coal required to melt a ton of steel. While no such ideal condition is possible, yet the author points out that it is time that careful thought be given to the saving of fuel supplies. Some of the points discussed as to possibilities of saving are:

1. Use of waste-heat boilers. 2. Imperfect or delayed combustion. 3. Blow-torch port. 4. Improvement in regenerator chambers.

The statement is made that there is no question but that the transition through which the open hearth is now passing will so increase the capacity of existing units that there will be practically no construction of new open-hearth plants required to meet the demands of steel for a number of years; but one of the biggest problems incident to the introduction of the rapidly operated furnace will be to get the raw material to the furnace and to handle the material on the casting side.

Melting Aluminium for Rolling Mill Sheet.*

By John A. Lange.

This paper gives the data obtained from an investigation of the melting efficiency and ease of operation of four types of furnaces for melting aluminium. The investigation also included tests of types of slab moulds. The four types of furnaces used were (1) gas fired cast-iron pot type; (2) tilting reverberatory, open gas flame type; (3) combination revolving and tilting reverberatory type, and (4) same as the third type except having longer melting chamber, different speed of revolution of drums and having a gas mixer attachment.

The general furnace practice is described in detail and the furnace operation data is given. From the results of the test, it was found that the fourth type of furnace gave most satisfactory results, the writer favouring quick melting, with a furnace temperature of not to exceed 1,800 deg. F. Blistered sheet is primarily attributed to poor ingot and, secondarily, to long melting periods at high temperatures, poor furnace and slab skimming, and over annealing. The "drawing quality" of metal cannot be entirely judged by analysis, but silicon is most objectionable, iron should not exceed ¼ of 1 per cent. and copper if higher than ¼ of 1 per cent. tends to rapidly harden the sheet when rolled. The rolling of slabs is also described.

* Paper read before the Rochester Meeting of the American Foundrymen's Association.

A Study of Carburisation in the Manufacture of Synthetic Cast-Iron.*

By Clyde E. Williams and C. E. Sims.

General Considerations.

The study described in this Paper was undertaken in connection with the sponge iron investigations being conducted at the Northwest Experiment Station of the U.S. Bureau of Mines at Seattle, Washington. Sponge iron is being made by low-temperature reduction of iron oxide, and subsequently melted and carburised to produce pig iron. The sponge iron contains about 80 per cent. metallic iron, 10 per cent. iron oxide, and 10 per cent. silica, alumina, and lime. In melting the sponge iron, difficulty was experienced in introducing sufficient carbon into the iron, and, except in a few instances, a product containing over 3 per cent. carbon could not be obtained. The degree of carburisation varied with the different carburising agents added.

This study of carburisation in the manufacture of synthetic cast-iron was carried out because of the lack of definite information regarding the factors which influence carburisation. Instead of the sponge iron, steel scrap in the form of turnings, punchings, and clippings was used, because it eliminated a number of variables introduced by the impurities in the sponge iron. The results of this investigation consequently have direct bearing upon the present practice of making synthetic cast-iron from steel scrap.

Previous investigators have emphasised the difficulty of introducing much more than 3 per cent. carbon in synthetic cast-iron made in the electric furnace, but they have not discussed in detail the relative efficiencies of the different carburisers, the effect of impurities, or the various operating details. Turnbull used charcoal, coal or coke, ferro-silicon, lime, steel turnings, and steel scrap, but did not mention the relative advantages of the various forms of carbon employed. He rarely obtained iron the carbon content of which was over 3 per cent., and then only with much destruction to the furnace lining and roof. Later he apparently improved his practice and was able to get as high as 3.5 per cent. carbon, seldom obtaining less than 3 per cent. Turnbull used, instead of ferro-silicon, "another product which reduces the cost and helps the carbon content." This was evidently silicon carbide. Keller melted steel turnings with carbon that was in approximately the same state of division as the steel turnings. Ordinary coke and wood charcoal, depending on their cost, were used interchangeably. Iron containing 3 per cent. carbon is mentioned, and an analysis is given of white iron containing 3.55 per cent. carbon. In discussing Keller's article, Brooke said that it was easy to obtain a carbon content of 2.75 per cent., but difficult to get one of 3.75 per cent., especially if a roof were used on the furnace. Richards, in the same discussion, reports that the use of the roof was abandoned in order to obtain the high carbon content of 3 per cent. Keller used a lime slag to effect desulphurisation and to make possible easier electrical operation of the furnace. Since the work described in this Paper was completed, Morrison has reported that anthracite coal-slack containing 5 per cent. ash was a more effective carburiser than coke breeze containing 25 per cent. ash, and that crushed charcoal was superior to the anthracite coal, although charcoal in large pieces hindered carburisation.

In addition to the direct effect of different kinds of carburisers, the amount and the nature of the slag might be expected to have some bearing on the rate or degree of carburisation. Intimate contact between the molten iron and the carburiser is of importance. Keller found that ". . . . the introduction of a certain quantity of silica into the charge will increase the silicon in the product with a correspondent reduction of the amount of carbon therein." This reduction in the amount of carbon may have been due to the mechanical effect of the siliceous slag, and not to the introduction of silicon into the metal.

The available knowledge of the influence of some of the elements on the stability of cementite in the iron-carbon system naturally suggests the question of their effect on carburisation during the production of synthetic cast-iron. High silicon in blast-furnace iron tends to produce graphite instead of cementite. The presence of silicon might, therefore, be expected to reduce the rate of carburisation during the production of synthetic cast-iron from steel. Manganese stabilises cementite in cast iron but does not suppress the action of silicon to a marked extent. Furthermore, alloys of iron and manganese, such as spiegeleisen and ferro-manganese, contain more carbon than does pig-iron, the carbon content usually increasing as the ratio of manganese to iron increases. Hence, it would be expected that the presence of manganese would assist in the carburisation of iron, and increase the degree of saturation of carbon. Sulphur tends to stabilise cementite. Hence, if it affected carburisation of the molten iron at all, it would be expected to assist. On the other hand, sulphur is present in iron as FeS which would have the effect of decreasing the amount of iron available for absorbing carbon. The percentage of iron affected by the amounts of sulphur ordinarily met with in commercial practice would, of course, be so small that the actual decrease due to this cause in the amount of carbon absorbed would pass unnoticed. Phosphorus in solid solution in iron, lowers the solubility of carbon, and it has been shown that, in the presence of silicon, phosphorus assists in the precipitation of graphite. Heike claims that small amounts of phosphorus favour the separation of graphite and that large amounts prevent it.

All of these factors have been considered in this study; although it has been realised that, due to the relatively small amounts of impurities usually met with, the effect upon the final total carbon would be small; also, that most of these effects have been determined from the cooling of cast irons, and in this study the reserve process has taken place. However, there was some likelihood that certain tendencies would be set up by the presence of the different impurities, and it was hoped that the foregoing information would be of assistance in determining the most desirable conditions for carburisation.

The solubility of carbon in iron increases with the temperature. The results of the work of Ruff and Goeke, and of Ruer and Biren, show that the solubility of carbon in iron increases at the rate of 0.2 or 0.3 per cent. for each rise in temperature of 100 degrees, between 1,200 and 1,800 deg. C. Hence a difference in temperature of 100 deg. C. would not be expected to have much effect upon the rate of carburisation of iron. However, at the temperature of the arc in the electric furnace the solubility of carbon is relatively high, and, therefore, it is to be expected that carburisation would be rapid in the metal directly beneath the arc. The direct arc by its stirring action should also aid carburisation. High temperatures should be particularly desirable toward the end of the operation when complete saturation of the iron with carbon is being more nearly approached.

Description of Methods and Operations.

The following studies were conducted with the hope of determining some of the factors that influence the carburisation of iron in making synthetic cast iron. They were first made in a small 2-electrode pit-type furnace, which held about 50 lbs. of metal and took an input of about 50 kw. The cross-section of the crucible was 9 by 15 ins. Three-inch square graphite electrodes were used. The furnace was first lined with magnesite brick and the bottom and sides then faced with magnesia-alumina spinel containing 2.5 parts dead-burned magnesia and 1 part alundum. The

* A Paper read at the Baltimore meeting of the American Electrochemical Society. Published by permission of the Director, U.S. Bureau of Mines.

power input to this furnace corresponded to 2,000 kw. per ton of metal or 50 kw. per sq. ft. of hearth area. Realising that this furnace was overpowered, a larger furnace was constructed and used in repeating the experiments performed in the 50-lb. furnace. The larger furnace was of the roofed, tilting type. It held 300 lbs. of metal and took power at the rate of 75 to 100 kw. The hearth was lined with magnesite brick and covered with magnesia-alumina spinel. The sides and roof were made of corundite brick, a highly aluminous fireclay, experience having shown that this brick gave more satisfactory results than silica brick. The cross-section of the hearth was 17 by 24 in. Two 3-in. round graphite electrodes were used. The power input corresponds to about 600 kw. per ton of metal, or 35 kw. per sq. ft. of hearth area. When the furnace had been pre-heated to about 400 deg. C., 1,000 kw.-hrs. per ton was required for melting and carburising to 3.5 per cent. C. Considering its small size, it would seem that the furnace was not overpowered to a large degree. The power factor was about 96 per cent. during all of the experiments.

The electrode consumption was at the rate of 11 lbs. per ton of iron. Part of this consumption was due to oxidation of the electrode at the roof, since no cooling rings were used.

To determine the relative values of the various carburisers, most of the commercial forms of carbon were employed for comparison. The list includes graphite, resistor carbon, charcoal, coal-tar coke, low-ash coke, high-ash coke, silicon carbide, calcium carbide, and a lime-coke mixture to simulate calcium carbide. No anthracite coal was available.

The experiments cover many runs both in the small pit furnace and in the larger tilting furnace. For the work in the pit furnace mild steel turnings were used as the raw material. This material is similar to that used by Keller in making synthetic cast-iron. Fifty pounds of turnings per charge was used in all of the runs. In all tests the carburiser was crushed to pass a 10-mesh screen.

Before charging, the furnace was pre-heated to a red heat. The order of charging was as follows: About 20 lbs. of the charge, consisting of alternate layers of steel turnings and carburiser, was put in the furnace. The current was then introduced, and the remainder of the charge added as rapidly as melting progressed. When the entire charge was melted, a sample for chemical analysis was ladled out and poured into a graphite mould 1 in. square and 1½ ins. long. Some of the metal was also poured on the concrete floor and covered with diatomous earth to prevent chilling. This latter piece was later broken and its fracture examined. Samples for analysis and fracture were taken every 10 or 15 minutes, and when the fracture showed no further change, it was assumed that conditions had approached equilibrium and the charge was tapped.

In many of the runs in which the carburiser was added with the cold metal, the first sample taken after the charge was molten, contained over 3 per cent. carbon. In order, therefore, to investigate the rate of carburisation in the lower concentrations of carbon, it was necessary to melt the turnings in the absence of the carburiser, and then, after the first sample had been taken, to add the carburiser to the surface of the molten metal. It was more difficult to melt the steel turnings without the carburiser than with it, due to the relatively higher melting point of steel. The ferro-alloy and other additions were usually made with the first portion of the turnings, but at times they were made after the metal had been melted.

The carburiser was always added in excess of the amount theoretically necessary; usually it amounted to about 10 or 12 per cent. of the weight of steel turnings. In such a small furnace it was found to be a distinct disadvantage to have too thick a layer of carburiser on the surface of the melt, because the current would be carried through the carburiser without directly heating the metal. Hence, a layer of carburiser about ½-in. thick was kept on the surface, making sure, however, that there were no bare spots of metal exposed.

For experiments in the larger furnace, steel scrap in the form of boiler punchings and clippings was used, instead of the less pure steel turnings. The boiler punchings and clippings varied in size from 1 to 10 in., were uniform in composition, and contained 0.05 per cent. sulphur and phosphorus, 0.5 per cent. manganese, 0.5 per cent carbon, and 0.2 per cent. silicon.

A charge in the large furnace consisted of 300 lbs. of steel scrap and about 20 lbs. of carburising material. The furnace was pre-heated by placing a piece of electrode in the bottom and drawing an arc on it. Then about 200 lbs. of the steel scrap and 10 lbs. of the carburiser were charged, the carburiser being placed so that some of it rested between the pieces of steel and some lay on top acting as a cover. The furnace was operated by direct arcing, and when most of the charge had melted, an additional 100 lbs. of steel scrap was added. The rest of the carburiser was added at intervals. The addition of ferro-silicon and other alloying material was made just before the metal was entirely melted.

The electrodes were controlled by means of a drum and worm-gear operated by hand. In order to insure arcs of equal intensity on both electrodes, two ordinary incandescent lamps were placed on a shelf near the meter board. These had a common connection to the metal bath and each a separate connection to one electrode. Thus, the brilliancy of the filament of each lamp was proportional to the voltage drop between the bath and the electrode to which that lamp was connected. This arrangement provided a sensitive and convenient means of regulation, assured smooth electrical operation, and thus made comparable the results obtained in the various runs.

(To be continued.)

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—As a competitor in the patternmaking competition in connection with the recent Birmingham exhibition, I should like to show my disapproval of the manner in which the patterns have been returned. A friend and myself sent our patterns by parcel post, and both enclosed a note asking that they should be returned the same way, and the cost of postage deducted from the 2s. 6d. which was returnable to us.

Those responsible, however, returned the patterns by rail, with the result that I have had 4s. 9d. to pay, and my friend, whose pattern was in a box weighing nearly 28 lbs., had 9s. 4d. to pay. The respective postage charges were 1s. 3d. and 1s. 6d.

Those who despatched them should certainly have tried not to put competitors to unnecessary expense.

July 19, 1922. TYNESIDE COMPETITOR.

Deaths.

MR. W. B. SURRIDGE, under-manager at the Dowlais Works, has died as the result of an accident. He was 30 years of age.

MR. S. WILKINSON, principal of the firm of Samuel Wilkinson & Sons, fireclay manufacturers, Blackley, Elland, died on July 16, at the age of 86 years.

MR. J. D. SAGAR, a director of J. Sagar & Company, Limited, engineers, Canal Works, Halifax, was among those killed in the air disaster at Severne, Alsace Lorraine.

MR. J. A. SWIFT, the Yorkshire and Derbyshire agent of the Cambridge Scientific Instrument Company, Limited, a member of the Junior Engineering Society, and an associate of the Chartered Institute of Secretaries, has been killed in a motor accident at Sheffield. He was 35 years of age.

IN REGARD to the Rating of Machinery Bill, a letter has been addressed by the Federation of British Industries to Mr. Chamberlain, urging that in the interests of industry, if it is in any way possible, facilities should be given by the Government for the consideration of the further stages before the end of the present Session.

Manganese Bronze.

By F. A. Livermore, B.Sc.

During the past decade manganese bronze has been widely used. The requirements of marine construction, mining machinery, and other engineering work where corrosion offers a serious problem, have created a demand for a non-ferrous metal, which is highly resistant to corrosion, and at the same time useful as a substitute for steel in general constructional work without weakening the structure or increasing the weight of the various parts over that ordinarily used in the case of steel. Unfortunately we have no individual non-ferrous metal which satisfies all these conditions, consequently metals were compounded in the endeavour to obtain the desired properties. Excellent results were obtained; probably the most popular of such substitutes has been manganese bronze; this alloy resists at least the corrosive influence of sea water, and has a tensile strength approaching that of mild steel. Manganese bronze made its first appearance about 1876.

Since the alloy contains only a small percentage of manganese (as is shown in Table I.) the name is somewhat misleading. The alloy is nothing more than a special brass, to which has been added, by the proper method of alloying, comparatively small percentages of aluminium, iron and manganese. These additions are made with the definite purpose of strengthening the alloy and rendering it more dense and close-grained than the ordinary yellow brass. "Manganese bronze" is theoretically the incorrect nomenclature for the alloy. Since a bronze is essentially an alloy of copper and tin, that name cannot appropriately be applied to an alloy which does not contain more than a trace of tin, without causing some confusion; "manganese brass" is a nomenclature proposed which is more correct; however, since the alloy is best known to the metal trade as "manganese bronze," the writer proposes to continue using this name in order not to cause any misunderstanding.

Manganese bronze should not contain much manganese, in fact not more than 0.5 per cent. in high-class bronze, so the consumption of manganese in such alloys is small. The object of the manganese is not so much to act as an ingredient of the alloy as to serve as a carrier of the iron necessary to ensure the required strength and elastic limit. The manganese serves one purpose only, to introduce the iron, for without the manganese, the iron would not alloy with the copper. Usually the manganese is added in the form of ferro-manganese; if added in large quantities it hardens the alloy, but not nearly as much as iron; such an addition considerably lowers the elastic limit.

Table I. showing the limits of the composition of manganese bronze:—

Element	Percentage.
Copper	55.0—60.0
Zinc	35.0—45.0
Iron	1.0.1.5
Manganese	0.25—3.0
Aluminium	trace—1.0
Tin..	trace—1.0
Lead	0.25—0.5

The wide variation in the composition has led some manufacturers indiscriminately to compound alloys from all manner of scrap, while other manufacturers lay great stress on the importance of using only the highest grades of raw material mixed to certain formulæ.

Virgin Metal Not Essential

According to the writer's experience, just as good results can be obtained from the use of scrap as from the use of virgin metals, providing due precaution is taken to ensure the scrap is free from injurious impurities such as arsenic, antimony, and free iron, and the alloy is thoroughly cleansed before use.

In the manufacture of low-grade manganese-bronze it has been found possible to utilise what would ordinarily be termed material of very low-grade, such as skimmings from the foundry, particularly skimmings and dross ordinarily recovered from brass rolling mills or cartridge-case plants, zinc dross recovered from galvanising plants, aluminium turnings that are ordinarily unrecoverable without a fair loss, etc., and other by-products and scrap materials that are not usable as re-melting scrap in foundry practice.

With a knowledge of the general chemical composition of each ingredient going into the heat, it is easy to produce a manganese bronze that will have the desired composition, and will require no other treatment than, possibly, the addition of a little zinc when re-melting for casting purposes. It is a well-known fact that such materials as zinc dross and foundry skimmings, both of which are full of dirt and oxides, cannot be recovered in a usable condition when melted separately in crucibles or by any of the ordinary methods of melting material, without an excessive loss due to volatilisation; but when the well-known reactions occurring in the manufacture of old-fashioned calamine brass are taken into consideration, it can be seen how the combination of zinc dross, brass skimmings and other highly oxidised materials melted in contact with charcoal will produce an alloy about as well dioxidised as the average high-zinc brass.

Manufacturing Considerations.

Contact while in a molten or semi-molten state of metallic copper and partly oxidised zinc in the presence of charcoal develops a condition extremely conducive to a thorough dioxidation and alloying of all the metallic ingredients. This reaction, together with the well-known dioxidising effects of aluminium, manganese and iron, which are part of the heat, contributes to the production of thoroughly dioxidised and dense material. Salt and charcoal are used as a flux on account of their excellent properties for gathering and fluxing off the dirt from the charge, the oxides of iron, manganese, etc., and the reduction of any copper oxides passing from the bath into the slag.

In charging the graphite crucible it is the usual custom to place the manganese hardener (generally ferro-manganese) at the bottom and on top of it zinc and brass dross with a thin layer of charcoal, after which the pot is filled up with foundry skimmings of brass and turnings, and the heat is melted in a coke-fired pit furnace, although this type of furnace is gradually being replaced by coke- and gas-fired tilting furnaces because of their increased efficiency, ease of control, higher temperature and speedier melting.

During the melting the heat is occasionally stirred or rabbled to clear the metal and bring all the ingredients into intimate contact. When the bath is melted, the aluminium scrap is added, and a requisite amount of zinc added to compensate for the loss by volatilisation. The crucible is removed from the furnace and thoroughly stirred to bring to the surface all suspended matter and oxides; this and the dross from the surface of the metal is carefully skimmed off, and the molten alloy is poured into ingots for re-melting purposes, after analysis has been made to determine the necessity of adding more zinc or otherwise correcting the composition of the mixture of several heats in order to obtain the desired composition.

By following the preceding it is able to produce an alloy that is sound and homogeneous and capable of being cast in ordinary foundry practice in the same manner as any of the so-called high-grades of manganese bronze, and will show good physical properties in the finished casting.

It may be added that care must be taken with the scrap. Sweepings, skimmings, ashes, etc., must be carefully sorted, and all extraneous matter removed before introduction into the pot.

Tables II. and III. show respectively the composition and the mechanical results obtained from test-pieces taken from castings produced with material treated by the method described in the preceding.

XUM

Table II. showing the composition of the material used:—

Heat.	Cu.	Zu.	Sn.	Pb.	Fe.	Al.	M.
1	55.90	41.09	0.36	0.40	0.89	0.55	0.80
2.. ..	55.18	41.54	0.51	0.34	1.04	0.48	0.91
3.. ..	55.53	41.32	0.47	0.34	0.93	0.50	0.91

Table III. showing physical properties of the ingots detailed in Table II.:—

Heat.	Maximum Stress. tons per sq. in.	Yield Point. tons per sq. in.	Elongation. per cent.
1 ..	31.8	22.0	22.1
2 ..	32.3	23.4	21.0
3 ..	32.0	22.5	21.5

Table IV. showing some physical tests of sand castings made from manganese bronze produced by the process:—

Tensile Strength. tons per sq. in.	Yield Point. tons per sq. in.	Elongation. per cent.
29.6	16.7	30.9
30.2	18.3	24.5
32.2	15.2	24.5
32.4	16.3	23.4

It can readily be seen from the foregoing tables that the physical and chemical properties of these alloys compare very favourably indeed with the so-called high-grade manganese bronze produced with virgin metals.

The fracture is characteristic; it has a fine uniform structure, with a tendency to silky grain, but predominently displays toughness and resiliency equal to any other grades of manganese bronze. Some objections may be raised to the use of by-products and scrap material in the manufacture of manganese bronze, because of the lead content of some of these by-products is high, and will so introduce into the alloy quantities of lead much higher than are desired.

However, from experiments made from time to time on manganese bronze with varying proportions of lead it has been shown conclusively that lead within certain limitations is not detrimental. No concrete cases have yet been reported in which lead under 0.75 per cent. has shown serious defects in the alloy or resultant castings; all the samples on which physical tests are given contain percentages of lead varying from 0.25 to 0.50 per cent. yet none of them shows any signs of detrimental effects due to the presence of this impurity.

From the tests, the evidence is fairly conclusive that manganese-bronze can be manufactured from scrap without resorting to the use of high-grade virgin metal, by simply applying the laws of metallurgy to practice.

A Study of the Change in the Grain Size of Silica Sand Through the Constant Addition of Clay.*

By R. J. Doty.

This paper gives the details of an investigation which refutes the commonly accepted theory that the constant addition of clay to sand where heap sand is used as a part of the batch, causes the facing to become finer and finer. As a result of this investigation it is stated that after a year's practice in using heap sand in the facing for steel castings and adding clay at each milling, the sand was more open at the end of the year.

The investigation was carried out by starting with a mixture of silica sand, average grain size 0.01283 in. and clay, average grain size, 0.01144 in. Moulds were made and cast repeatedly in the sand mixture, new clay and sand being added to keep the heap to size. Great care was taken to avoid the admixture of any foreign material. The standard mixture was:

84 quarts used sand
36 quarts new sand
5 quarts fire clay.

The results of the investigation showed that there was a considerable increase in grain size, as a result of the muller mixing, coating the sand grains with a film of clay. This increase of grain size caused the sand to become more permeable or open. Screen tests and the use of the microscope confirmed these results.

* Abstract of a Paper read before the Rochester Meeting of the American Foundrymen's Association.

Company News.

Mather & Platt, Limited.—Interim dividend, 3 per cent. actual, tax free.

Alliance Foundry Company, Limited, Limbury, Bedfordshire.—Capital £5,000 in £1 shares.

Yorkshire Electric Power Company, Limited.—Interim ordinary dividend, 3 per cent., less tax.

Electrical Distribution of Yorkshire, Limited.—Interim ordinary dividend, 7 per cent. per annum, free of tax.

General Engineering & Electric Welding Company, Limited.—Capital £2,000. Directors: F. Savertsen and G. P. Jones.

William King (Birmingham), Limited, 207, Vauxhall Road, Birmingham.—Capital £2,000 in £1 shares. Pattern makers, engineers, diesinkers, etc.

Helipebs, Limited, Premier Works, Quay Street, Gloucester.—Capital £5,000. Engineers, founders, etc. Directors: S. D. Lane and R. McDougall.

H. C. Tofield, Limited, Temple Passage, Upper Temple Street, Birmingham. Capital £2,000 in £1 shares. Electrical and general engineers, etc.

Yorkshire Amalgamated Products, Limited.—Gross profit, £31,800; net profit, £7,300; dividend, 2½ per cent.; reserve, £6,000; carried forward, £2,200.

Blacketh, Dunkerley & Company, Limited, Hull.—Capital, £1,000. Consulting engineers. Directors: F. Blacketh, H. Dunkerley, and G. H. M. Hutchinson.

Normanby Iron Works Company, Limited.—Final preference dividend, 6 per cent. per annum; final ordinary dividend, 6 per cent., making 12 per cent. for year.

Electric Supply Corporation, Limited.—Net revenue for 1921, £27,196; brought forward, £484; available, £27,681; repairs and renewal fund, £7,661; carry forward, £12,214.

Cullompton Electric Supply Company, Limited, Fore Street, Cullompton, Devon.—Capital £6,000 in £1 shares. Directors: G. G. Gedley, F. C. Sellwood, W. Plumpton, and W. T. Burnard.

Gibbins & Bodenham, Limited, Tube Works, Rotton Park Street, Birmingham.—Capital £15,000 in £1 shares. Metal manufacturers. Directors: R. Gibbins, A. Bodenham and M. H. Barnard.

Adamant Roller Mill Company, Limited, Lever Iron Works, Little Lever, near Bolton.—Capital £2,000. Milling machine manufacturers. Permanent directors: T. H. Chatton (chairman), and J. J. Fraser.

H. H. Powell & Company, Limited, Palace Chambers, Bridge Street, Westminster, S.W.—Capital £2,100 in 2,000 preference shares of £1, and 2,000 ordinary of 1s. Engineers. Directors: A. A. Blake and H. H. Powell.

Charles Yates & Company, Limited, Billiter House, Billiter Street, London, E.C.—Capital £5,000 in 4,900 ordinary shares of £1, and 2,000 employés' shares of 1s. Iron merchants. Directors: C. Yates and B. Daniel.

W. & T. Avery, Limited.—Balance of revenue account for year, £106,169; balance ordinary dividend, 10 per cent., less tax, making 15 per cent., less tax, for year; reserve, £10,000; carry forward, £36,163; brought forward, £25,020.

Hodgson (London), Limited, 2, Gerrard Place, Shaftesbury Avenue, W.1. — Capital £100. Inventors, patentees, mechanical and electrical engineers, etc. Permanent directors: F. A. G. Hodgson, H. R. Hodgson and E. J. Mason.

B. K. Morton & Company, Limited, 11, Queen Victoria Street, London.—Capital £15,000 in £1 shares, to adopt an agreement with B. K. Morton & Company, steel manufacturers, tool makers, engineers, etc. Directors: Mrs. E. Morton, B. A. Smith, and G. J. Morton.

John Richards & Company (Electrical Engineers), Limited, 9, High Street, Burton-on-Trent.—Capital £6,000 in £1 shares, to acquire the business carried on by J. Richards at 9, High Street, Burton-on-Trent, and 75, Victoria Street, Westminster, S.W. The business is not connected with that carried on by J. Richards as "John Richards & Company," at Longton.

Mond Nickel Company, Limited.—Accounts for two years: Profit for year ended April 30, 1921, £222,630; ditto, succeeding year, £299,042; brought forward, £114,795; balance, £610,383; dividends paid, £220,000; preference dividend for latter year, £175,000; interim ordinary dividend, 6d. per share, free of tax, £22,500; final ordinary dividend, 1s. per share, free of tax, making 1s. 6d. for year; income-tax, £110,000; carried forward, £37,883.

MR. P. J. PYBUS, of the English Electric Company, Limited, and Mr. J. Sampson, of John Brown & Company, Limited, are at present at St. Catharines, Ont., inspecting the plant of the English Electric Company of Canada. Both these gentlemen are directors of the Power, Traction and Finance Company, Limited, the Canadian interests of which are in the hands of the English Electric Company of Canada.

IRON AND STEEL MARKETS.

Pig-iron.

Markets for pig-iron during the current week suggest few fresh developments promising an early revival of more active conditions, and both in home and export conditions remain quiet and uneventful. In the South Staffordshire area business continues restricted, and can hardly be expected to show improvement until the holiday season has finished. Makers' anticipations of a substantial measure of relief in production costs by the recent reduction of rail transport charges have by no means been justified by results, the total saving on the carriage of raw materials and fuel only amounting to something like one shilling per ton. This, of course, does not permit of any sensible reduction in pig-iron prices, although consumers' opinions that lower levels in quotation are practically inevitable shortly has a restricting effect upon buying generally. A slight increase in demand for forge iron is reported in the Midlands, but so far it is insufficient to justify the relighting of additional furnaces. In the Cleveland market so far business has not been affected by the recent freeing of price adjustments, No. 3 foundry, which is apparently rather more plentiful than was expected, being down to 88s., and with business generally quiet, and the Scotch holidays on, there has been no real test of values.

Business in the East Coast hematite market continues flat and featureless, demand in the home trade having dwindled of late to minimum proportions, while shipments also are on a decreased scale. Consequently stocks have accumulated, and though makers are extremely reluctant to curtail production, some furnaces will certainly have to be damped down unless business soon shows some improvement. Prices show further weakness.

Finished Iron.

There is little fresh to add to previous comments on the finished iron position, which remains, as before, the least satisfactory section of the trade, with but faint encouragement to hope for any early improvement in present conditions. Even marked bar makers, normally fairly well employed, are now complaining of lack of fresh specifications, though still maintaining quotations firmly at the recent level of £13 10s., a price leaving a very poor margin of profit to producers. South Staffordshire crown bars remain very irregular. There are still some makers who decline to book anything at less than £11 15s., but on the other hand others are quite ready to cut that price. Belgian competition is again becoming aggressive to the makers of bolt and nut iron, the price quoted being £8 12s. 6d., whereas the very lowest price mentioned for such material produced in South Staffs. is £9 17s. 6d. to £10. The only thing that helps local makers to get any of this trade is the disposition of consumers to refuse to contract and to favour short purchases to cover immediate requirements. South Staffs. makers have some advantage under such conditions.

Steel.

Active business, as far as steel and its products are concerned, is at present mostly confined to semi-material for which the demand continues on an improving scale, some of the Sheffield plants now being operated full time, with indication of an early increase in productive capacity at some of the works. There is, however, considerable competition in this branch, both from home and foreign manufacturers. Sheffield soft basic billets at from £7 10s. to £7 15s. having to meet Lincolnshire material at £7 5s. All these quotations are declared to be barely remunerative, and any movement can only be upward. The heavy steel trade is making a good recovery, but in crucible steel things are very flat, with no immediate prospect of improvement. Overseas buying of mild steel is much better. The demand for motor steel is reviving to some extent, but for shipbuilding and railway steel, especially the former, there is only a limited demand. Orders in the finished steel branches are on an encouraging scale, and cash business with Russia for saws, files and other tools is improving.

Scrap.

The markets for scrap metal are still in an unsatisfactory condition, with a general tendency to lower prices. Consumptive demand at the moment shows little improvement, and holders of heavy stocks are inclined to accept business on lower terms than have been on offer of late, while, in some cases, deliveries are suspended until works become more actively employed. At Middlesbrough demand is slack, the following being the approximate quotations:—Heavy steel scrap, 60s.; steel turnings and cast-iron borings, each 45s.; heavy cast-iron machinery scrap in handy pieces, 79s. to 80s.; heavy wrought iron, bushelling and piling, 62s. 6d.; ditto special heavy forge, 70s. to 75s. per ton. All delivered works.

Tinplates.

Movements in the tinplate market at the moment indicate some slowing down of business, though the demand for stock qualities is still very fair, but forward buying the last week or so has fallen off considerably. Makers are well booked for August, but most of them will soon be wanting orders for delivery in the last quarter. So far quotations are being maintained, makers stating that there is no room for any material reduction if they are to have a working margin of profit. The standard sizes are quoted:—Coke tins, IC, 14 x 20, 112 sheets, 108 lbs., 19s. 6d. to 19s. 9d. per box; IC, 28 x 20, 112 sheets, 216 lbs., 39s. 3d. to 40s. per box; net, f.o.b. Wales. Cross substances are now quoted at round 3s. 6d. basis extra for each cross. Terneplates are in quiet request. Quotations run 18s. basis and upwards for usual specifications, net cash, f.o.b. Wales. The home demand for wasters is steady, quotations ruling firm at about previous rates.

Metals.

Copper.—Increasing firmness is at present the outstanding feature of the standard copper market, the slight fluctuations in values being mostly in the direction of advanced quotations. The strength of the position may be attributed to conditions in the States, where there has been a heavy fall in stocks of the metal, counterbalancing the decreased consumption on the Continent due to the disturbance of the European exchanges. The total American deliveries of refined copper for domestic use and export for the first half of this year, amounting to about 363,800 tons, are 118,265 tons in excess of the refinery output. Therefore, the United States stocks, which, according to Government figures, were equivalent to 223,214 tons on January 1 last, should have been reduced to about 104,000 tons during the last six months. Refined qualities of copper are also firm, electrolytic ruling £70 10s. per ton, and wire bars £71 10s. per ton. Current quotations:—*Cash*: Wednesday, £63; Thursday, £63 2s. 6d.; Friday, £63 5s.; Monday, £63 10s.; Tuesday, £63 7s. 6d. *Three Months*: Wednesday, £63 7s. 6d.; Thursday, £63 7s. 6d.; Friday, £63 12s. 6d.; Monday, £63 12s 6d.; Tuesday, £63 12s. 6d.

Tin.—Although still confined within comparatively narrow limits, values for standard tin maintain very steady levels, fluctuations in prices from day to day seldom disclosing more than fractional variations. The statistical position is, however, still somewhat difficult, the large holdings of Eastern producers constituting the weakest factor, apprehensions of a sudden liquidation of stocks on behalf of the Governments concerned having an adverse influence on movements this side. At the moment home consumers are only buying from hand-to-mouth, makers of tinplates having lately reduced orders to a considerable extent. The price of tin, however, may be expected to reach a higher level with an improvement in trade and industry, but hardly to such an extent as anticipated by the too optimistic holders. Current quotations:—tions:—*Cash*: Wednesday, £156; Thursday, £156 10s.; Friday, £157 5s.; Monday, £158; Tuesday, £158 5s. *Three Months*: Wednesday, £156 10s.; Thursday, £156 17s. 6d.; Friday, £157 10s.; Monday, £158 2s. 6d.; Tuesday, £158 7s. 6d.

Spelter.—Demand for spelter continues somewhat below average, but prices rule steady with, if anything, an upward tendency. Producers, however, still regard values as too low, and are therefore not overanxious to increase commitments. Current quotations:—*Ordinary*: Wednesday, £29 6s. 3d.; Thursday, £29 12s. 6d.; Friday, £29 12s. 6d.; Monday, £29 12s. 6d.; Tuesday, £29 15s. 6d.

Lead.—Attention in the market for soft foreign pig is mainly directed to prompt sales, and all available metal is readily absorbed by both home and Continental consumers. American advices report steady conditions with higher prices in prospect towards the close of the year. Current quotations:—*Soft foreign (prompt)*: Wednesday, £25 12s. 6d.; Thursday, £26; Friday, £26; Monday, £26; Tuesday, £25 17s. 6d.

Trade Talk.

MR. S. SUTCLIFFE has acquired the business of Bickerton & Johnson, machinery merchants, Hulme Street, Manchester.

CONSIDERABLE damage was done by a fire which broke out recently at the Mavon Engineering Works, Victoria Street, West Bromwich.

LEEDS ELECTRICAL CONSTRUCTION COMPANY, LIMITED, have removed their London office from 30, Queen Anne's Chambers, Westminster, to 12, Broadway, Victoria Street, Westminster, S.W.1.

BRITISH ELECTRIC VEHICLES, LIMITED, of Churchtown, Southport, have removed their sales department from Hamilton House, Bishopsgate, E.C., to the secretary's office at 1, Queen Victoria Street, London, E.C.

CONSIDERABLE OPPOSITION having been shown to the proposed Shipbuilding, Engineering and Allied Trades Exhibition at Glasgow, in November, there is every probability that the exhibition will not be held this year.

THE BALL-BEARING SUPPLY COMPANY, 56, Eagle Street, Southampton Row, London, W.C.1, have been appointed sole British agents for Officine Di Villar Perosa, ball-bearing manufacturers, Villar Perosa, Pinerolo, Italy.

LONDON FACTORS & AGENTS, LIMITED, 38, Parliament Street, London, S.W.1, have been appointed sole agents in London, the South of England, and South Wales for W. Warburton & Company, Limited, Turbine Works, Halifax.

JOHN M. TERRY & COMPANY, of Birmingham, have given up their office at 85, Newington Causeway, London, S.E.1, but their late manager, Mr. A. F. Holmes, is continuing the business in conjunction with his brother, under the style of Holmes Brothers.

THE SHEFFIELD ENGINEERING EMPLOYERS' ASSOCIATION is seeking a reduction in the wages of bricklayers, bricklayer's labourers, carpenters and joiners, plumbers and painters employed in the engineering establishments and steel works in Sheffield. It is proposed to hold a conference with the representatives of the various parties with the object of determining the reduction.

THE suggested reduction of the war bonus in the engineering industry was further discussed at a conference between representatives of the Engineering Employers' Federation and the executives of unions affiliated to the Engineering and Shipbuilding Trades Federation recently. Sir Allan Smith, for the employers, submitted similar terms to those which are already being balloted upon by the A.E.U. and other unions—namely, a reduction of 5s. 6d. a week on July 31, and similar reductions to operate on August 28 and September 25. The union representatives agreed to submit the proposed reduction to a ballot of their members, to be returnable by July 28.

AT A MEETING of the Leadgate Urban District Council, the Building Committee recommended the adoption of a plan for the erection of 42 houses in Watling Street for the Consett Iron Company, Limited. A member said that they had already plenty of two-roomed houses. He would like the Council to ask the Consett Iron Company to reconsider the plans. Mr. Costello thought that they ought to make provision for smaller houses for people without big families. The Company had mostly built four-roomed houses, but there appeared to be a necessity for houses with one bedroom and a large kitchen. The Council ultimately decided to adopt the recommendation of the committee.

MR. W. R. DOUGLAS SHAW, 18, John Street, Adelphi, London, W.C.2, intimates that it is proposed to form an Association of Manufacturers of Non-Corrodible and Anti-Corrosive Products, in order to create new and increased demands for the products and processes of its members. The following firms have already intimated that they are in accord with the formation of such an Association:—Arthur Ross, Hotchkiss & Company, Limited, Cuirass Products, Limited, Henry Wiggin & Company, Limited, Meldrums, Limited, Thomas Firth & Sons, Limited. A meeting will be called shortly to further the scheme, one of the objects of which is to organise public exhibitions of non-corrodible and anti-corrosive products.

Staffordshire Iron and Steel Institute.

The summer excursion of the Staffordshire Iron and Steel Institute took place on Wednesday, the 19th inst., when a party comprising about thirty officers and members visited the works of the British Thomson-Houston Company, Limited, at Rugby. The party included Mr. F. J. Cook, Vice-President, Messrs. H. Silvester, F. Somers, and I. E. Lester, past-Presidents, J. Piper, Treasurer, and C. B. Pugh, Secretary. The party were met by representatives of the directors, and spent the afternoon in touring the various shops in which a large quantity of electrical plant is being turned out. The works have been greatly extended during the war period, and about four-fifths of the 12,000 workpeople are now in full employment. New business has made steady progress during the past six months of the year, and some big contracts are in hand, chiefly for the provision of lighting plant for large municipalities and corporations in England and the various British Dominions. Very large machinery is installed for boring, milling, and turning heavy turbines. Special attention was given to the foundry, which is equipped with three cupolas varying from three to ten tons capacity, and is served by ten powerful cranes. A somewhat unusual feature is that the casting operations are carried out on three floors, communication with which is maintained by an electric lift. The party were afterwards entertained at tea by the directors, when a hearty vote of thanks was passed on the proposition of Mr. F. J. Cook, seconded and supported by Messrs. Somers and Silvester. In acknowledging the vote, Mr. R. Dumas, the works manager, spoke of the great progress made in the equipment of electrical driving and service generally in connection with iron and steelworks.

Personal.

THE LATE Mr. E. Wilmshurst, of Hewitt and Worth, iron merchants, left £7,765.

THE LATE MR. H. GREENLEAVES, joint managing director of United Brass Founders and Engineers, Limited, Empress Foundry, Manchester, left £15,320.

MR. W. D'ARCY MADDEN, general manager of Hick, Hargreaves & Company, Limited, of Soho Ironworks, Bolton, has been elected managing director of the company.

MR. J. HINCKLEY, iron and steel merchant, East Parade, Sheffield, who died on December 25 last, left estate of the gross value of £10,857, with net personalty £4,659.

LIEUT.-COLONEL SIR H. DENNIS READETT-BAYLEY has been elected chairman of the board of Industrial Steels, Limited, of Sheffield. Mr A. G. Osborne, of Malden, Surrey, has also been elected a director.

GANISTER, CUPOLA BLOCKS, FIRE BRICKS,
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3 useful tools in One

HERE is a new and inexpensive 3-in-1 tool that will quickly save its first cost and thereafter give sheer profit. This is how you use the Carbic Adjustable Acetylene Torch. On a large and costly sand-mould, for example: examine deep awkward corners with the torch set to lighting position; without moving the torch move adjusting ring over the air ports to give a clear hot bunsen flame and "dry" the mould—then set the ring to give a smoky soot-laden flame which rapidly deposits an even layer of finely divided 100% pure carbon. A boy can use this new torch efficiently.

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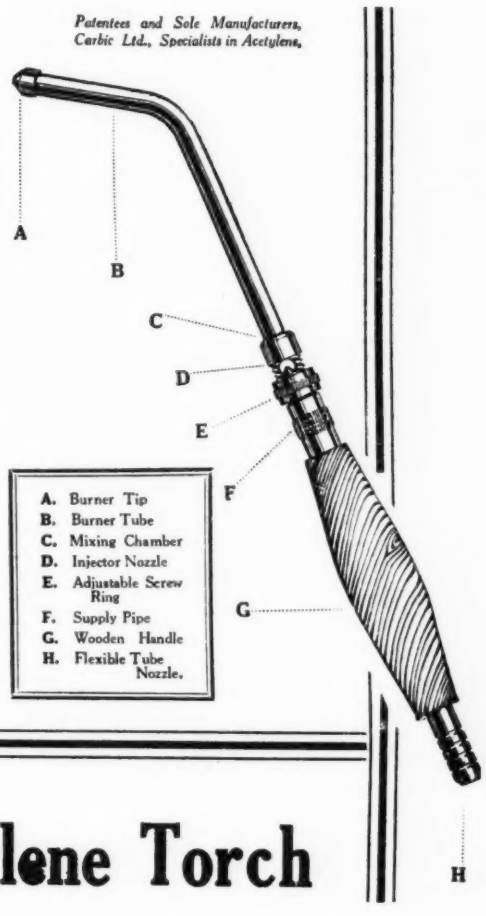

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Adjustable Acetylene Torch

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MOULDING MACHINES. Electric, Air & Hand Power.
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BRASS RECOVERY MACHINES. New Process.

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	63	7	6
Three months	63	12	6
Electrolytic	70	10	0
Tough	66	5	0
Best selected	66	5	0
Sheets	94	0	0
India	83	10	0
Wire bars	71	7	6
Do. Aug.	71	7	6
Do. Sept.	71	7	6
Ingot bars	71	0	0
H.C. wire rods	75	10	0
Off. aver. cash, June	62	0	11 1/16
Do. 3 mths., June	62	8	5 1/16
Do. Settlement June	62	1	0 3/4
Do. Electro, June	70	1	2 3/4
Do. B.S., June	67	12	2 3/4
Aver. spot price, copper, June	61	19	11 1/4
Do. Electro, June	70	15	8 1/2

Solid drawn tubes .. 13½d.
Brazed tubes .. .. 13½d.
Wire .. .. .. 10½d.
Yellow metal rods .. 6½d.
Do. 4x4 Squares .. 8½d.
Do. 4x3 Sheets .. 9½d.

BRASS.

Solid drawn tubes .. 11½d.
Brazed tubes 13d
Rods, drawn .. .. 10½d.
Rods, extruded or rolled 6½d.
Sheets to 10 w.g. .. 9½d.
Wire .. .. .. 9½d.
Rolled metal .. 9½d.

TIN.

Standard cash	158	5	0
Three Months	158	7	6
English	158	0	0
Bars	159	10	0
Chinese	156	10	0
Straits	159	0	0
Australian	159	10	0
Eastern	160	10	0
Banca	158	2	6
Off. aver., cash, June	152	12	3 1/4
Do. 3 mths., June	153	14	5 1/4
Do. Sttlment June	152	12	3 1/4
Aver. spot, June	152	11	1

SPELTER.

Ordinary	29	15	0
Remelted	26	15	0
Hard	21	15	0
Electro 99.9	34	0	0
English	30	0	0
India	22	15	0
Prime Western	29	17	6
Zinc dust	45	0	0
Zinc ashes	4	15	0
Off. aver., June	27	16	1 3/4
Aver., spot, June	27	17	11 1/2

LEAD.

Soft foreign ppt	25	17	6
English	26	15	0
Off. average, June	24	3	2 3/4
Average spot, June	24	14	2

ZINC SHEETS.

Zinc sheets, English	36	0	0
Do. V.M. ex. whf.	36	0	0
Dutch	36	0	0
Rods	41	0	0
Boiler plates	34	0	0
Battery plates	34	10	0

ANTIMONY.

English regulus	25	15	0
Special brands	32	10	0
Chinese	24	5	0
Crude	14	10	0

QUICKSILVER.

Quicksilver 11 7 6 to 12 0 0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—
45/50% 13 0 0
75% 23 0 0

Ferro-vanadium—
35/40% 17/9 to 18/- lb. va.

Ferro-molybdenum—
70/75% 6/6 lb. mo.

Ferro-titanium—
23/25%, carbonless 1/2 lb.

Ferro-phosphorus, 20/23%, £20

Ferro-tungsten—
80/85%, carbon free 1/5 lb.

Tungsten metal powder—
98/99% .. .. 1/8 lb.

Ferro-chrome—
4/6% car. £24
6/8% car. £23 10
8/10% car. .. £23 0

Ferro-chrome—
Max. 2% car. .. £65
Max. 1% car. .. £75
Max. 0.70% car. .. £90
67/70%, carbonless 1/9 lb.

Nickel—99%, cubes or pellets £160

Cobalt metal—98/99% 12/- lb.

Aluminium—98/99% £100

Metallic Chromium—
96/98% .. .. 5/- lb

Ferro-manganese (net)—
76/80%, loose .. £15
76/80%, packed .. £16
76/80%, export .. £14 10

Metallic manganese—
94/96%, carbonless 2/4 lb.
Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten .. .. s. d. 2 6
Finished bars, 18% tungsten 3 0
Per lb. net, d/d buyers' works.

Extras—
Rounds and squares 3 in. to 8 in. inclusive 4d. lb.
Rounds and squares under ½ in. to ¼ in. 3d. lb,
Flats under 1 in. by ⅛ in. to ½ in. by ¼ in., and all sizes over four times in width over thickness .. .. 3d. lb.
Bevels of approved sizes and sections .. 6d. lb.
If in coils .. .. 3d. lb.
Packing .. ..£3 ton.
Bars cut to length 10% extra

Scrap from high-speed tool steel—
Scrap pieces .. .. 3d.
Turnings and swarf .. 1d
Per lb. net, d/d steel makers' works.

SCRAP.

South Wales—	£	s.	d.	£	s.	d.
Heavy Steel	3	10	0	3	15	0
Bundled steel & shearings	2	18	0	3	7	6
Mixed iron & steel	2	17	6	3	5	0
Heavy cast iron	3	7	6	3	15	0
Good machinery for foundries				4	0	0

Cleveland—			
Heavy steel	3	0	0
Steel turnings	2	5	0
Cast-iron borings	2	5	0
Heavy forge	3	12	6
Bushelled scrap	3	2	6
Cast-iron scrap	3	19	0

Lancashire—			
Cast iron scrap	4	2	6
Heavy wrought	3	10	0
Steel turnings	2	2	6

London—	£	s.	d.
Copper (clean)	55	10	0
Brass (clean)	30	0	0
Lead (less usual draft)	21	0	0
Tea lead	19	0	0
Zinc	16	0	0
New aluminium cuttings	65	0	0
Braziery copper	46	10	0
Gun metal	40	0	0
Hollow pewter	120	0	0
Shaped black pewter	70	0	0

Above are merchant's buying prices delivered yard.

PIG-IRON.

N. E. Coast—	
Foundry No. 1	95/-
Foundry No. 3	88/-
Forge No. 4	85/-
Mottled	80/-
Hematite No. 1	95/-
Hematite M/Nos.	94/-
Midlands—	
Staffs. common	—
,, part-mine forge	—
,, ,, foundry	—
,, Cold blast	240/-
,, basic	—
Northants forge	70/- to 72/6
,, foundry No. 3	77/6 ,, 80/-
,, basic	82/6
Derbyshire forge	75/-
,, foundry No. 3	82/6
,, basic	80/-
Scotland—	
Foundry No. 1	100/-
,, No. 3	95/-
Hematite M/Nos.	110/-
Sheffield (d/d district)—	
Derby forge	82/6
,, foundry No. 3	86/6
,, basic	—
Lincs. forge	86/6
,, foundry No. 3	86/6
,, basic	86/6
E.C. hematite	107/6
W.C. hematite	115/-
All d/d in the district.	
Lancashire (d/d eq. Man.) —	
Derby forge	—
,, foundry No. 3	92/6
Northants foundry No. 3	—
Cleveland foundry No. 3	—
Staffs. foundry No. 3	—
Lincs. forge	—
,, foundry No. 3	—
Summerlee foundry	112/-
Glengarnock foundry	114/6
Gartsherrie foundry	114/6
Monkland foundry	112/-

FINISHED IRON & STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.
Bars (crown)	£10 10 to £12		
Angles	£11 to £12	10	0
Tees to 3 united ins.	£11 10 to 13	0	0
Nut and bolt	10	0	0
Hoops	14	0	0
Marked bars (Staffs.)	13	10	0
Gas strip	11	2	6
Bolts and nuts, ⅝ in. × 4 in.	20	10	0

Steel—			
Ship plates	10	0	0
Boiler plates	13	10	0
Chequer plates	10	10	0
Angles	9	10	0
Tees	10	10	0
Channels	8	15	0
Joists	10	0	0
Rounds & squares 3-in. to 5½in.	10	10	0
Rounds, under 3in. to ⅜in.	9	10	0
Flats, over 5in. wide and up	10	0	0
Flats 5in. to 1¼in.	8	10	0

	£	s.	d.
Rails, heavy	9	10	0
Fishplates	14	10	0
Hoops	12	0	0
Black sheets, 24 g.	12	0	0
Galv. cor. sheets, 24 g.	16	0	0
Galv. fencing wire, 8 g. plain	16	0	0
Rivets, ½ in. dia	14	0	0
Billets, soft	7 5 0 to 7	7	6
Billets, hard	8	0	0
Sheet bars	7 5 0 to 7	7	6

PHOSPHOR BRONZE.

	Per lb basis.
Strip	1 3
Sheet	1 3½
Wire	1 3½
Rods	1 2½
Tubes	1 6
Castings	1 1

Delivery 3 cwt. free to any town.
10% phosphor copper, £40 above price of B.S.
15% phosphor copper, £50 above price of B.S.
Phosphor tin (5%), £30 above price of English ingots.
CHARLES CLIFFORD & SON LIMITED, BIRMINGHAM.

NICKEL SILVER, SHEET METAL, WIRE AND TUBES.

	Per lb.
Ingots for raising	11d. to 1/5
Rolled—	
To 9 in. wide	1/5 to 1/11
To 12 in. wide	1/5½ to 1/11½
To 15 in. wide	1/6½ to 2/0½
To 18 in. wide	1/7½ to 2/1½
To 21 in. wide	1/8½ to 2/2½
To 25 in. wide	1/9½ to 2/3½
Ingots for spoons and forks	11d. to 1/5
Ingots rolled to spoon size	1/2 to 1/8

Wire round—
3/0 to 10. G. .. 1/8½ to 2/3½ with extras according to gauge

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.	Dols.
No. 2X foundry, Phila.	27.64
No. 2 foundry Valley	24.00
No. 2 foundry, Birm.	18.00
Basic	25.96
Bessemer	26.77
Malleable	26.46
Grey forge	25.27
Ferro-manganese 80 % delivered	70.82
Bess. rails, h'y, at mill	40.00
O.-h. rails, h'y, at mill	40.00
Bess. billets	35.00
O.-h. billets	35.00
O.-h. sheet bars	35.00
Wire rods	40.00
	Cents.
Iron bars, Phila.	1.92
Steel bars	1.70
Tank plates	1.70
Beams, etc.	1.70
Skelp, grooved steel	1.70
Skelp, sheared steel	1.70
Steel hoops	2.50
Sheets, black, No. 28	3.15
Sheets, galv., No. 28	4.15
Sheets, blue an'l'd, 9&10	2.40
Wire nails	2.40
Plain wire	2.25
Barbed wire, galv.	3.05
Tinplate, 100-lb. box	$4.75

COKE (at ovens).

Welsh foundry	32/6
,, furnace	22/6
Durham & North. foundry	28/-
,, furnace	23/6
Other Districts, foundry	27/6
,, furnace	22/6

SWEDISH IRON.

Bars, hammered basis sizes Basis price £22 to £23

	£ s. d.
Rolled Ordinary— Assortment ..	17 0 0 to
Nail Rods— Square, round and flats ..	17 10 0

Keg Steel nom. £38 to £40
Faggot Steel nom. £30 to £32

Blooms—
Single welded .. £10 to £11

Billets—
Single and double welded £13 to £14

Pig-Iron—
Grey, white or mottled .. £8 to £8 15 0

Prices are without engagement. All quotations are f.o.b. Gothenburg, net cash against documents there.

TUBES.

Up to and incl. 6 in.

Gas	..	55%
Water	..	50%
Steam	..	45%

Tube prices are now free.

TINPLATES.

I.C.Cokes,	20×14,	box	19/9
	28×20,	„	39/6
	20×10,	„	28/3
	18¾×14,	„	20/-
I.X.		,	45/-
I.X.X.		„	51/-
F.C.B.Y.	21×13⅝	„	37/6
C.V.B.G.	16½×15,	„	34/9
I.C.W.	20×14,	„	17/3
„	28×20,	„	34/-
„	20×10,	„	23/9
„	18¾×14,	„	17/9
Terneplates,	28×20,	„	36/-

DAILY FLUCTUATIONS.

Standard Copper (cash).

	£	s.	d.		
July 19	63	0	0	dec.	2/6
„ 20	63	2	6	inc.	2/6
„ 21	63	5	0	„	2/6
„ 24	63	10	0	„	5/-
„ 25	63	7	6	dec.	2/6

Electrolytic Copper.

July 19	70	0	0	dec.	10-
„ 20	70	10	0	inc.	10/-
„ 21	70	10	0	No change	
„ 24	70	10	0	„	
„ 25	70	10	0	„	

Standard Tin (cash).

July 19	156	0	0	inc.	17/6
„ 20	156	10	0	„	10/-
„ 21	157	5	0	„	15/-
„ 24	158	0	0	„	15/-
„ 25	158	5	0	„	5/-

Tin (English ingots)

July 19	155	10	0	inc.	10/-
„ 20	156	0	0	inc.	10/-
„ 21	157	0	0	„	20/-
„ 24	157	10	0	„	10/-
„ 25	158	0	0	„	10/-

Zinc Sheets (English).

July 19	36	0	0	No change
„ 20	36	0	0	„
„ 21	36	0	0	„
„ 24	36	0	0	„
„ 25	36	0	0	„

Spelter (ordinary).

July 19	29	6	3	inc.	1/3
„ 20	29	12	6	„	6/3
„ 21	29	12	6	No change	
„ 24	29	12	6	„	
„ 25	29	15	0	inc.	2/6

Lead (English).

July 19	26	10	0	inc.	5/-
„ 20	26	15	0	„	5/-
„ 21	26	15	0	No change	
„ 24	26	15	0	„	
„ 25	26	15	0	„	

SHROPSHIRE IRON Co., Ltd.

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To all Specifications.

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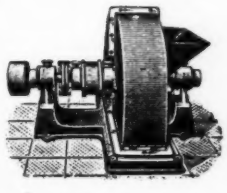
BEST H. C. COPPER & BRONZE WIRE a speciality.

Medals:—Sydney (Bronze) 1879, New Zealand (Gold) 1882, Liverpool (Silver) 1886, Adelaide (Gold) 1887, Franco-British Grand Prix (Highest Award) 1908.

THE "BREAKIR" is the most Simple, Reliable, and Efficient **SAND MIXER** on the Market.



LOW power consumption.

CLEAN and Sounder Castings, therefore a good investment.

CAPACITIES:
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FOUNDRY MANAGER or FOREMAN (38), disengaged, wants post; technical training; 23 years' experience grey iron and non-ferrous metals; general engineering and high-class light castings; greensand, drysand, loam, plate and machine; piece rate fixing; efficient cupola practice; good organiser; good references.—Box 216, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

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WALTER STANLEY.

Gilmorton Road, Lutterworth, Leicestershire.

METALLURGIST AND FOUNDRY MANAGER (28), who has just relinquished control of a Foundry, desires permanent, progressive post. Green, dry and loam moulding, electric, Siemens, Bessemer and crucible melting; University metallurgical degree course, M.I.M. and M.I.S.I.—Box 224, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

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THE PROPRIETOR OF THE PATENT No. 22,792 of 1910, for "Method of bessemerizing copper matte" is desirous of entering into arrangements by way of licence and otherwise on reasonable terms for the purpose of exploiting the same and ensuring its full development and practical working in this country.—All communications should be addressed in the first instance to HASELTINE, LAKE & Co., Chartered Patent Agents, 28 Southampton Buildings, Chancery Lane, London, W.C.2.

ENDLESS STEEL BELTS.—The Owner of British Patent No. 147667, which relates to the manufacture of Endless Steel Belts by Rolling from Seamless Tubing, is desirous of entering into negotiations for the granting of licences thereunder on reasonable terms.—Communications please address to DICKER & POLLAK, 20-23, Holborn, London, E.C.1.

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FOR SALE.

Three Lancashire Boilers, 30 ft. x 7 ft. 6 in., now insured at 150 lbs. pressure. Two Marine Boilers, 10 ft. 4 in. x 12 ft. 2 in. diameter, reinsure 150 lbs. pressure. One Loco Type Boiler, barrel 4 ft. 7 in. long x 3 ft. diameter, reinsure 80 lbs. pressure. Eight good Second-hand Single-ended Three-furnace Marine Boilers, 10 ft. 2 in. long x 16 ft. 3 in. diameter, Foxe's patent Furnaces, reinsurable at 145 lbs. per sq. in. working pressure. One Lancashire Boiler, 25 ft. x 6 ft., reinsure 80 lbs. pressure. Egg-ended Air Receiver, 22 ft. 10 in. long x 4 ft. 6 in. diameter. 23 Roof Principals, each 21 ft. span x 5 ft. 3 in. rise in centre.

Catalogue of Stock Machinery, 5-6,000 Lots Free on Application. Inspection Invited

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SHEFFIELD.

ONE new 2-ton Geared Ladle for sale; price £20.—For further particulars apply to TURNER, ATHERTON & COMPANY, LIMITED, Denton.

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50 H.P. Horizontal Hornsby Crude Oil Engine, maker's latest type; Sturtevant complete Air Heating installation; 3 in. and 4 in. Electric-driven Centrifugal Pumps, by Gwynnes, 220 volts D.C.; two magnificent Three-throw Hydraulic Pumps, by Lee, Howl, motor driven, 4½ in. rams, 220 volts D.C. Bargain prices.

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NORTHAMPTON IRON ORE.—For sale, by order of Mortgagees, Farm containing 238 acres, valuable bed of Ironstone believed to exist thereunder, land adjoining worked. Above Farm key position to railway and adjoining land. Price freehold (cheap), £12,000.—Apply to MESSRS. MERRY & SON, Auctioneers, Northampton.

GROUND GANISTER, Fire Clay, Clean Sharp Sand for Furnace Bottoms, Astbury Silica Company (Established 30 years).—Write, D. BOULTON, Kidsgrove, Stoke-on-Trent.

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Expert metallurgical, analytical and consulting service given by old-established firm of metallurgical chemists (chemical analysis, general foundry work, mixtures, research, etc.). Write at once for lists and details.—BEECROFT & PARTNERS, LIMITED, Valley Road, Chesterfield; also at Norfolk House, Cannon Street, Birmingham.

£250

SAND BLAST ROOM PLANT.

Size of Chamber 18 ft. × 14 ft. with necessary fittings and separator plant for two operators; this plant was only erected 1918, and is therefore **PRACTICALLY NEW.**

May be viewed at Airco Works, Hendon. The above price includes delivery on rail, but no compressor plant; I can supply *from stock* a suitable compressor and receiver for £80.

ALEX. HAMMOND,

"BOXTED"—SLOUGH.

The only *stock* of *used* foundry machinery in the country is at my works here, boxes, furnaces, moulding machines, etc., any foundry want supplied.